

THE ANNALS
AND
MAGAZINE OF NATURAL HISTORY.

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND
CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY'.)

CONDUCTED BY

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VOL. III.—NINTH SERIES.  
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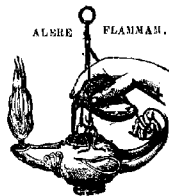
1919.

"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstinuata; à verè eruditis et sapientibus semper exculta; malè doctis et barbaris semper inimica fuit."—LINNÆUS.

"Quel que soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—BRUCKNER, *Théorie du Système Animal*, Leyden, 1767.

..... The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain-thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.



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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[NINTH SERIES.]

"..... per litora spargite muscum,
 Naiades, et circum vitre-as considite fontes:
 Pollice virgineo teneros hic capite flores:
 Floribus et pictum, diva, repleto canistrum.
 At vos, o Nymphæ Craterides, ite sub undas;
 Ite, recurvato variata corallia trunco
 Velite muscosa e rupibus. et mihi conchas
 Ferte, Deus pelagi, et pingui conchyliis suona."
N. Porthean Giannettasi, Vol. 1.

No. 13. JANUARY 1919.

I.—*On the African Genera of Wingless Brachyderinæ with Connate Claws (Coleoptera, Curculionidæ).* By GUY A. K. MARSHALL, D.Sc.

[Plate I.]

HAVING had occasion recently to identify a number of South African weevils of the genus *Strophosomus*, it became evident that several readily separable groups had been associated under this name; and, moreover, as might have been anticipated, a comparison of the Ethiopian species with the typical European forms reveals the presence of constant differences, which render it desirable that they should be separated generically. This has necessitated an examination of all the allied African genera, for which a synoptic key is here given. Unfortunately, two genera, each comprising a single species, are unknown to me and have therefore been omitted, viz.: *Edophronus*, Schh., from Natal, and *Blosyridius*, Frm. (C. R. Ent. Belg. xxxv. 1891, p. 298), from Somaliland. The former, judging from Lacordaire's description of the tarsi, is related to *Mimaulus*, and the latter will come near *Proscaphaladeres*. Schönherr has also assigned to the genus *Cueorrhinus* three South African

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species with which I am unacquainted. They probably do not belong to that genus as now understood, and appear to be related to the species here described under *Leurops*, from which they differ in the complete absence of the median stria on the forehead—an unusual character in this group. The Madagascar forms have not been included, as they are now being revised by M. A. Hustache.

In discriminating the genera use has been made of characters drawn from the epistome, mandibles, and mentum, which have not been previously employed in this group, but which seem likely to be useful for separating the principal subdivisions.

Unless otherwise stated, the types of all the new species are in the British Museum.

Key to the Genera.

- 1 (24). Epistome well defined, bounded by a distinct carina or obtuse ridge; cutting-edge of mandibles with a median projection or tooth.
- 2 (17). Mentum entirely devoid of setae*.
- 3 (6). Tarsi narrow, setose beneath.
- 4 (5). Front tibiae produced externally into a long process; corbels of hind tibiae enclosed; mandibles squamose *Mimaulus*, Schh.
- 5 (4). Front tibiae not produced externally; hind corbels open; mandibles not squamose *Mimaulodes*, gen. nov.
- 6 (3). Tarsi broad, spongy beneath; corbels of hind tibiae open, bare.
- 7 (10). First ventral segment with the hind margin rounded; lower surface of rostrum more or less concave, the normal longitudinal impressions entirely or nearly obliterated.
- 8 (9). Elytra without any humeral prominence; head separated from rostrum by a fine stria which curves strongly forwards in the middle; rostrum strongly narrowed in front; funicle not squamose *Pomphus*, gen. nov.
- 9 (8). Elytra with a conspicuous humeral prominence; head separated from rostrum by a deep, gently sinuous furrow; rostrum subquadrate; funicle squamose *Bradybanon*, gen. nov.
- 10 (7). First ventral segment with the hind margin straight or sinuate; lower surface of rostrum with two deep

* Some species of *Procephaladeres* have a row of flat scales along the front edge of the mentum, but no true setae.

- longitudinal or oblique impressions, with a convex space between them.
- 11 (12). The three median ventral segments subequal in length; forehead trisulcate; scape short and stout, the externally visible portion much shorter than the funicle; rostrum separated from the head by a furrow that extends quite to the side *Blosyrus*, Schh.
- 12 (11). Second ventral segment longer than the third or fourth; forehead with at most a single furrow; scape slender, the exposed portion almost or quite as long as the funicle.
- 3 (14). Metasternum between the coxae very much shorter than the middle coxae; mandibles squamose, with a well-marked longitudinal dorsal carina running from the scar to the base *Prosephenaluteres*, Schh.
- 14 (13). Metasternum as long as or only slightly shorter than the middle coxae; mandibles without a dorsal carina.
- 15 (16). Scrobes strongly dilated behind; scape not exceeding the middle of the eye; funicle and mandibles clothed with scales; eyes finely faceted *Proscopus*, gen. nov.
- 16 (15). Scrobes almost parallel-sided; scape reaching hind margin of eye; funicle and mandible entirely devoid of scales; eyes comparatively coarsely faceted [*Strophosomus*, Billb.]
- 7 (2). Mentum setose.
- 18 (21). Corbels of hind tibiae very oblique, lying almost entirely on the inner face of the tibiae, their upper fringe of setae ascending the dorsal edge of the tibiae in a straight line (as in *Tanymecus*); second ventral segment distinctly longer than the third or fourth, hind margin of the first more or less sinuate in the middle, the incision shallow.
- 9 (20). Rostrum separated from the forehead by a stria; eyes very prominent and produced backwards *Protostraphus*, gen. nov.
- 10 (19). Rostrum continuous with the forehead; eyes simple, only slightly convex *Leurops*, gen. nov.
- 21 (18). Corbels of hind tibiae terminal, not ascending the tibiae; the three median ventral segments subequal in length, hind margin of the first segment straight, the incision deep.
- 22 (23). Corbels of hind tibiae enclosed; scape slender, clavate; forehead trisulcate;

- mentum with a transverse row of five or six setæ *Pseudoblosyrus*, gen. nov.
- 23 (22). Corbels of hind tibiæ open; scape very broadly dilated; forehead without any longitudinal furrow; mentum with only two setæ *Platycopes*, Schh.
- 24 (1). Epistome indistinct and quite undefined; cutting-edge of mandibles straight or rounded and without any median tooth; basal part of metepisternum angularly produced internally; hind coxæ reaching the elytra.
- 25 (26). Corbels of hind tibiæ open; metepisternal suture distinct in its basal half only; mesepisterna meeting the elytra at the extreme base; rostrum continuous with the forehead *Synechops*, gen. nov.
- 26 (25). Corbels of hind tibiæ broadly enclosed; metepisternal suture distinct throughout; mesepisterna broadly separated from the elytra by the mesepimera.
- 27 (36). Rostrum separated from the forehead by a transverse furrow.
- 28 (35). Tarsi with two claws; mentum setose.
- 29 (32). Furrow separating the rostrum from the head straight or with a forward curve.
- 30 (31). Ventral intercoxal process truncate or gently rounded; front margin of prosternum without any prominences; furrow separating the rostrum from the head straight or slightly sinuous *Ectatopsides*, Bovie.
- 31 (30). Ventral process strongly angulated; margin of prosternum with a prominence on each side above the coxæ; furrow separating the rostrum from the head deeply curved forwards ... *Enasane*, Pasc.
- 32 (29). Furrow separating the rostrum from the head angulate, with the apex of the angle directed backwards.
- 33 (34). Punctures on elytra in regular rows; eyes not produced backwards *Cychrotonus*, Pasc.
- 34 (33). Punctures on elytra partly irregular; eyes produced backwards *Eucrines*, Jekel.
- 35 (28). Tarsi with only one claw; mentum devoid of setæ *Gyponychus*, Pasc.
- 36 (27). Rostrum not separated from the forehead by a transverse furrow or stria. *Embolodes*, Mshl.

Genus MIMAULUS, Schh.

To the characters cited by Schönherr (Mant. Sec. Curc. p. 18) and Lacordaire (Gen. Curc. vi. p. 33) the following

points may be added:—Mandibles multisetose, squamose, with a distinct median tooth; mentum bare and deeply sunk in its cavity. Antennæ with the funicle not squamose. Gular margin of the prosternum deeply sinuate; mesepimeron very small and not separating the mesepisternum from the elytron at the base; metasternum at its shortest much shorter than the mid-coxæ, metepisternal suture complete, metepisternum not dilated at its base, hind coxæ broadly separated from the elytra. Venter with the intercoxal process truncate and as broad as the hind coxa; hind margin of segment 1 gently arcuate, its length behind the coxa greater than that of segment 2, which is longer than 3 or 4.

As at present known, the genus is confined to South-east Africa, south of the Limpopo.

Genus *MIMAULODES*, nov.

Head deeply constricted behind the eyes and with a central furrow which does not reach the vertex; eyes quite lateral, nearly flat and oblique, as seen from above, so that the head is broadest at their projecting hind margins. *Rostrum* about as long as the head and separated from it by a straight transverse furrow, strongly narrowed in front; epistome well defined, nearly three times as broad as long, shallowly sinuate in front, and the hind margin forming a low curve; mandibles bearing five or six setæ, not squamose, with a strong median tooth, the scar flat and almost circular; mentum bare, immersed; scrobes oblique, almost straight and parallel-sided, the upper edge touching the lower margin of the eye; lower surface of rostrum without longitudinal impressions, but shallowly excavated for the reception of the antennæ. *Antennæ* very short, squamose; scape reaching the middle of the eye, strongly clavate; funicle with joint 1 much longer and broader than 2, 3–7 very short and gradually widening. *Prothorax* much broader than long, the base arcuate in the middle and slightly sinuate at each side, the sides rounded. *Scutellum* invisible. *Elytra* fused together and strongly inflexed at the sides, only slightly broader at the rounded shoulders than the prothorax, the longitudinal outline forming a very low curve continuous with that of the pronotum, the posterior declivity almost vertical. *Sternum* with the gular margin shallowly sinuate; mesepisternum meeting the elytron only at the extreme base, the mid-coxæ very narrowly separated; metasternum much shorter than the mid-coxæ, its episternum not dilated

inwardly at the base, the episternal stria complete, the hind coxæ widely separated from the elytra. *Venter* with the intercoxal process slightly angulated at the base and narrower than the coxa; segment 1 with the hind margin straight, its length behind the coxa equal to that of 2, which is longer than 3 or 4. *Legs* short; tibiae armed with stout spines, but the external apical angle not produced, the corbels of the hind pair open, squamose and very oblique; tarsi narrow, setose beneath, not spongy.

♂ unknown.

Genotype, *Minaulodes fimbriatus*, sp. n.

The general form is entirely that of *Minaulodes*, and the insects are similarly covered with a thick earthy incrustation, so that several of the structural characters given above can only be observed when the specimen has been scraped.

Minaulodes fimbriatus, sp. n.

Integument pale brown, densely clothed with grey scales mingled with a natural earthy indumentum, and nearly always more or less coated with mud.

Head with stout, dark, suberect setæ and a dense patch of paler ones above each eye; eyes nearly circular and with a complete ring of pale scales. *Rostrum* almost flat above, with a very shallow transverse impression near the apex, so that the apical area appears to be raised; the sides quite vertical, so that no sign of the scrobe can be seen from above, the dorsal edge obtusely angulated above the base of the scrobe. *Prothorax* twice and a half as broad as long, broadest near the base and much narrower in front; the integument, when scraped, appears uneven and finely rugulose, being set with short, subrecumbent, stout, dark setæ, and there is along the lateral margin an uneven fringe of very long, upwardly curved setæ. *Elytra* broadly ovate, the sides gently rounded, broadest about the middle, the apical outline broadly rounded; the base not fitting very closely to the prothorax, jointly sinuate in the middle and rounding away at the sides; the dorsal surface with very shallow and broad sulci, the narrower raised intervals each bearing a row of stout, suberect, dark setæ, while at the shoulders and along the dorsal margins is an outstanding fringe of much longer setæ, these being longest at the shoulders and gradually diminishing behind. *Legs* densely squamose and with stout raised setæ; anterior pairs of tibiae with four spines along the apical edge, two or three on the apical third of the dorsal

edge, and one on the lower edge; hind tibiae also with four apical spines and two on the lower edge, the corbel with a dorsal border of two to four short, closely set spines and a longer terminal one.

Length 3-3½ mm., breadth 2-2½ mm.

TRANSVAAL: Benoni, 22. xi. 17 (*E. Buckles*).

Described from five specimens forwarded by the Division of Entomology, Pretoria, with a note that the species was lamaging the leaves and bark of *Eucalyptus viminalis*.

Genus POMPHUS, nov.

Head short and broad, with a central stria that reaches the vertex and another on each side about midway between it and the eyes, behind which there is a deep constriction; eyes quite lateral, very prominent, subconical, not or but slightly sloping backwards, their greatest depth behind the middle. *Rostrum* strongly narrowed in front, longer than the head and separated from it by a stria which runs from the eye to the apex of the outer stria on the forehead, and there making a sharp angle runs forwards to the apex of the median stria; from the middle of the base diverge two oblique abbreviated furrows; epistome sharply defined, almost an equilateral triangle, the sides forming a very low carina; mandibles multistictose, with only a few scales and an obtuse median tooth, the scar almost circular; mentum bare, immersed; scrobes narrow, deep, bare, and almost straight in the basal two-thirds, the upper edge ending a little below the lower margin of the eye. *Antennae* with the scape rather slender, abruptly clavate and reaching beyond the middle of the eye; funicle not squamose, joint 1 as long as but thicker than 2, the remainder bead-like. *Prothorax* at least twice as broad as long, truncate at base and apex. *Scutellum* invisible. *Elytra* broadly ovate, the longitudinal outline moderately convex, not continuous with that of the pronotum, the basal margin jointly sinuate and elevated, the angles projecting, the punctation more or less irregular. *Sternum* with the gular margin sinuate, the front coxae nearer to it than to the hind margin, the front margin raised into a prominent ridge on each side from the eye nearly as far as the coxae; mesepisternum meeting the elytron at the base; metasternum between the coxae hardly half as long as the mid-coxae, the episternal furrow complete, the episternum not produced inwardly at the base, the hind coxae broadly separated from the elytra. *Venter* with the

intercoxal process rounded and narrower than the coxa; segment 1 (behind the coxa) longer than 2, and 2 longer than 3, the hind margin of segment 1 arcuate. *Legs* short and rather stout; femora moderately clavate and simple; tibiae unguiculate, the corbels of the hind pair oblique, bare, and open, but with the apical edge slightly bent inwards; claws connate.

In the ♂ the fifth ventral segment is shorter and flat, in the ♀ it is a little longer and slightly convex.

Genotype, *Strophosomus kirschi*, Faust (Ent. Nachr. xi. 1885, p. 88).

Pomphus denticollis, sp. n. (Pl. I. fig. 3.)

Black, with grey or sandy scaling, the pronotum with a very broad median brown stripe, and the elytra with very variable dark brown markings, which are sometimes almost entirely obliterated.

Head almost flat on the forehead and set with stout erect setae, the integument quite hidden by the scaling. *Rostrum* with the sides strongly convergent from the eyes to beyond the middle, thence nearly parallel; upper surface with two deep sulci strongly diverging from the centre of the base as far as the middle of the disk, the lateral areas outside them being shallowly impressed; the central carina is prominent where it meets the epistome, but diminishes behind and disappears about the middle; the clothing as on the forehead. *Antennae* with the apical half of the scape squamose; funicle with joints 3, 4, and 6 subequal and slightly longer than broad, 5 a little shorter, 7 as long as 6 but distinctly broader. *Prothorax* twice and a half as broad as long, the base (when seen clear of the elytra) not broader than the apex; the sides, as seen from above, distinctly denticulate, there being a specially marked projection close to the base, and the apical angles prominent; apical margin strongly reflexed down the sides, the ridge thus formed ceasing abruptly on a line with the outer edge of the coxa; upper surface strongly convex transversely, closely set with rather indefinite granules (the rugose sculpturing being hidden by the scaling), and with a central furrow that reaches neither the base nor the apex; the longitudinal outline only slightly curved, the apex being only a little lower than the base. *Elytra* with the sides strongly rounded, broadest about the middle, scarcely striate, but with rather irregular rows of punctures, which are conspicuous through the scaling and often duplicated; the intervals broad, finely aciculate

(beneath the scaling), and each bearing a single row of stout, flattened, erect setae.

Length $4-4\frac{3}{4}$ mm., breadth $2\frac{1}{2}-2\frac{3}{4}$ mm.

PORTUGUESE E. AFRICA: Beira (P. A. Sheppard).

This species probably represents on the coast the very closely allied *P. kirschi*, Fst., which at present is known only from Nyasaland. The latter differs in having the sides of the prothorax simply rounded and not denticulate, the lateral areas of the rostrum are not impressed, the setae on the elytra are distinctly longer and more slender, and the scales on the elytra are for the most part rather sharply pointed behind instead of being broadly rounded.

Described from 1 ♂ and 5 ♀.

Genus BRADYBAMON, nov.

Head with a short central furrow and slightly raised at the sides to form an obtuse eyebrow, which is higher behind than in front; eyes quite lateral, nearly circular, moderately prominent, and not produced backwards. *Rostrum* subquadrate, separated from the forehead by a deep sinuous furrow that distinctly reaches the sides, lower surface flattened or slightly concave; epistome forming a sharp acute angle behind, the bounding carinae unusually high and finely laminate, the front margin rather shorter than the sides; mandibles multisetose, not squamose, with a median tooth, the scar flat and almost circular; mentum bare, somewhat sunk in its cavity; genae deeply impressed, the posterior angle rather prominent. *Antennae* with the scape abruptly clavate and reaching about the middle of the eye; funicle squamose, joint 1 equal to or longer than 2, the others short, 7 the broadest. *Scutellum* invisible. *Elytra* with the sides forming a straight slope from the base to the well-marked subhumeral prominence, the basal margin sinuate; in profile, the outline of the posterior declivity forms almost a semicircle, the apex being inflexed so that it lies in front of the middle of the declivity. *Sternum* with the gular margin gently sinuate, the centro-sternite forming an elongate tubercle; mesepisternum meeting or or very narrowly separated from the elytra; metasternum much shorter than the mid-coxae, with a distinct antecoxal fold, the episternal furrow deep and complete, the episternum narrow and not angulate inwardly at the base, the hind coxae separated from the elytra. *Venter* with the intercoxal process gently rounded and as broad as the coxa; the hind margin of segment 1 curved, so that segment 2 is much

shorter in the middle than at the sides, its length at the former point being about equal to that of 3 or 4. *Legs* rather short and stout; tibiae with a sharp mucro, the corbels of the hind pair open and bare; the claws connate.

All the specimens examined appear to be females.

Genotype, *Strophosomus granicollis*, Boh.

Thanks to the kindness of Prof. E. B. Poulton, F.R.S., I have been able to examine the cotypes of *S. granicollis*, Boh., in the Sommer collection, which he recently presented to the Oxford Museum.

From the description, it seems fairly certain that *Strophosomus verrucicollis*, Fst. (Ann. Soc. Ent. Belg. 1899, p. 390), from the Congo, also belongs to this genus.

The angulate elytra and tuberculate thorax would at once distinguish these insects from the other African "*Strophosomus*," and they have more the appearance of very small *Blosyrus*, which may however be distinguished by the very different structure of the epistome and lower surface of the rostrum, the more prominent eyes, and the straight hind margin of the first ventral segment.

Key to the Species.

- | | |
|---|-----------------------------|
| 1 (6). Prothorax with small, close, confluent tubercles throughout. | |
| 2 (3). The two median furrows on the rostrum subparallel; the two basal joints of the funicle equal; punctures on elytra more or less irregular | <i>granicollis</i> , Boh. |
| 3 (2). The two median furrows on the rostrum strongly divergent in front; joint 1 of the funicle longer than 2. | |
| 4 (5). Elytra marginate at the base, the rows of punctures more or less irregular or duplicated | <i>swalei</i> , sp. n. |
| 5 (4). Elytra not marginate at the base, the rows of punctures quite regular | <i>regularis</i> , sp. n. |
| 6 (1). Prothorax punctate on the disk and tuberculate laterally | <i>verrucicollis</i> , Fst. |

Bradybamon swalei, sp. n. (Pl. I. fig. 6.)

♀. Colour piceous, with dense earth-brown scaling; pronotum with a broad, median, darker brown stripe, which gradually widens from apex to base; elytra with an ill-defined dark stripe running obliquely from behind the shoulder to beyond the middle of stria 2 and edged behind with an indefinite pale stripe; the apical area with irregular dark brown and paler patches; these markings may become more or less obsolete.

Head with a short longitudinal impression on each side adjoining the supra-ocular ridge, the vertex transversely impressed; eyes very convex, deepest slightly behind the middle. *Rostrum* as long as its basal width, the dorsal area broadest at the base and gradually narrowed in front, with a shallow central impression containing a low scale-covered carina, on each side of it an oblique furrow running from near the centre of the base to the middle of the disk, and beyond this again an irregular shallow longitudinal impression; as seen from above the posterior angles of the genæ project strongly outwards, about three-fourths as far as the eyes. *Antennæ* with joint 1 of the funicle distinctly longer than 2, 3 as long as broad, 4-6 bead-like and transverse, 7 longer and broader. *Prothorax* much broader than long, truncate at the apex, the base gently arcuate and as broad as the apex, the basal angles rounded off, the sides moderately rounded, broadest about the middle, the apical constriction shallow; the upper surface scrobiculate, set with low confluent tubercles, and with an irregular central furrow. *Elytra* subquadrate, nearly as broad as long ($3\frac{1}{2} \times 4$ mm.), the sides almost parallel from the subhumeral prominence to beyond the middle, the basal margin raised, broadly rounded behind; with very shallow furrows containing rows of punctures that are more or less irregular and duplicated, except near the suture and extreme lateral margins; the intervals rather uneven and set with irregular rows of short, stout, erect setæ; the scales small, closely overlapping, pointed, and deeply fluted.

Length 5-6 mm., *breadth* 3-3½ mm.

PORTUGUESE E. AFRICA: Caia, Zambesi R. (Dr. H. Sacle).

Described from three specimens.

In addition to the characters given in the key, *B. grani-collis*, Boh., differs in being a distinctly narrower insect, the eyes are larger, the genæ are scarcely visible from above, and the setæ on the elytra are longer and more numerous.

Bradybanon regularis, sp. n.

♀. Colour black, with uniform earth-brown scaling.

Head not transversely impressed on the vertex, the forehead with lateral impressions; eyes relatively large, not very convex, deepest behind the middle. *Rostrum* subquadrate, about as long as broad, the sides parallel and vertical, so that the genæ are scarcely visible from above; the upper surface with two median sulci, which diverge

strongly from the base to the middle of the disk and enclose a low median scale-covered costa, and on each side of these an indistinct longitudinal impression. *Antennæ* with joint 1 of the funicle longer than 2, the remaining joints short and gradually widening outwardly. *Prothorax* much broader than long, the base and apex of equal width, the former arcuate, the latter truncate, the sides very strongly rounded, broadest much before the middle; the upper surface closely set with small low confluent tubercles, and with an indistinct central furrow. *Elytra* oblong-ovate, parallel-sided from the subhumeral prominence to beyond the middle, very broadly rounded behind, the basal margin not raised; with very shallow sulci, each containing a single row of deep close punctures; the intervals only slightly convex and bearing a single row of broadly truncate, scale-like, erect setæ.

Length $3\frac{3}{4}$ – $4\frac{1}{4}$ mm., breadth 2 – $2\frac{1}{4}$ mm.

ZAMBEZI R.

Described from two specimens.

GENUS PROSCEPHALADERES, Schl.

To this genus are here referred all the African "*Strophosomus*" having subglobose elytra. Apart from their somewhat different facies, they may be distinguished from the other African species with which they have hitherto been associated by the following points:—The mentum is entirely devoid of true setæ, though in most of the species there is a row of scales along its anterior edge—a very unusual character; the corbels of the hind tibiæ are more nearly terminal in position; the first joint of the funicle is never longer than the second, being rarely equal to it and usually distinctly shorter; the apical margin of the rostrum is deeply sinuate; and the hind coxæ are distinctly separated from the elytra.

The true European *Strophosomus* differ in having non-squamose and non-carinate mandibles, non-squamose funicles, a distinctly longer metasternum, and more coarsely faceted eyes.

The described species which should be placed here are: *Strophosomus aspericollis*, Fhs., *S. lineatus*, Fhs., *S. variabilis*, Fhs. (Olv. K. Vet.-Ak. Förh. 1871, pp. 13, 14), *S. binotatus*, Mshl., and *S. salisburyensis*, Mshl. (Proc. Zool. Soc. 1906, pp. 912, 913); and more than a dozen additional undescribed species are known to me.

Genus *Proscopus*, nov.

Head about as long as its width between the eyes, with a central furrow that almost reaches the vertex; eyes lateral, prominent, semicircular. *Rostrum* about as long as the head, narrowed in front, separated from the forehead by a deep furrow that reaches the sides; epistome short, well defined, but the sides not carinate, the front margin shallowly sinuate; mandibles squamose (setae abraded), without any longitudinal dorsal carina, but with an obtuse median tooth, the scar indistinct and subtriangular; mentum bare, much wider in front than behind and rather deeply sunk in its cavity, which is more oblong than usual, the basal angles being almost right angles; scrobes lateral, curved, and squamose, becoming markedly wider and shallower behind, the upper edge below the lower margin of the eye. *Antennae* with the scape rather stout, cylindrical, and gradually widening from near the base; funicle stout, squamose, the two basal joints of equal length, the remainder bead-like and subequal. *Prothorax* transverse, truncate at base and apex. *Scutellum* minute. *Elytra* subtruncate at the base, not constricted or marginate, without any humeral prominence, the apices jointly rounded. *Sternum* with the gular margin truncate, the coxae in the middle of the prosternum; mesosternum longer than usual, the episternum meeting the elytron at the base; metasternum between the coxae as long as the mid-coxae, with a very shallow antecoxal fold, the episternum not angularly produced internally at the base, the episternal suture almost obliterated, the hind coxae narrowly separated from the elytra. *Venter* with the intercoxal process slightly angulate and broader than the hind coxae; segment 2 longer than 3. *Legs* rather slender; corbels of the hind tibiae open, bare, and terminal; claws connate.

♂ unknown.

Genotype, *Proscopus marginatus*, sp. n.

The elongate metasternum is quite unusual in the African members of this group, and the general facies of the only known species is more like that of a Tanymericine of the genus *Iphisomus*.

Proscopus marginatus, sp. n. (Pl. I. fig. 4.)

♀. Black, with rather thin grey scaling (through which the shiny integument is clearly visible) and a few whitish markings; head with a narrow ring of whitish scales round

the eyes, expanding into a broad patch beneath, the setæ on the forehead slightly raised; prothorax with a narrow central whitish stripe, a broad lateral one behind the eye, and an ill-defined one above the coxæ, the setæ recumbent; elytra with numerous recumbent, scale-like, brownish setæ and the following whitish markings: a sutural stripe from the base to the middle, another on interval 7 starting a little before the middle and ending some distance from the apex, a short basal stripe at the shoulder continuous with the upper lateral one on the thorax, and a marginal stripe, which only reaches stria 10 in the basal half, gradually extending to stria 9 behind the middle and widening still more at the apex; along the dorsal striae there are irregular spots of whitish scales, and the lower surface is unevenly clothed with similar scales.

Head rugosely punctate, the forehead flat, with two very irregular longitudinal impressions on each side of the central furrow; a shallow impression immediately below the eye. *Rostrum* rugosely punctate, the disk shallowly impressed and with a very broad and deep central furrow in the basal half; an obtuse ridge on each side, beyond which the sides slope gradually to the scrobes; the genæ not impressed. *Prothorax* nearly twice as broad as long, the sides moderately rounded, broadest in the middle, evenly and very rugosely punctate throughout, without any furrow or carina, and the basal margin not raised. *Elytra* regularly elliptical, the dorsal outline strongly curved and raised high above the pronotum, the posterior declivity becoming vertical on a line with the apex of stria 5; striae shallow and containing deep separated punctures on the disk, the punctures shallower and the striae deeper at the apex and sides; the intervals almost flat and much broader than the striae. *Legs* with fairly dense pale scales, the tibiae with rather long suberect setæ, the hind pair granulate internally.

Length $6\frac{1}{2}$ mm., *breadth* $3\frac{1}{4}$ mm.

CAPE COLONY: Namaqualand.

Described from a single specimen.

Genus *PROTOSTRAPHUS*, nov.

Head with a central furrow and constricted behind the eyes, which are produced backwards. *Rostrum* strongly narrowed in front, separated from the forehead by a short stria or sulcus that does not nearly reach the sides, which are almost vertical, so that the scrobes are not visible from above, the apex almost truncate; epistome well defined,

almost an equilateral triangle; mandibles densely squamose (occasionally bare—*P. sparsus*, Fls., and *P. longulus*, Boh.), multisetose, with a distinct median tooth, the scar variable; mentum with numerous erect setae on the anterior half, usually arranged in a tuft of three to six on each side, the basal half sunk in the cavity; scrobes passing well below the eyes, more or less squamose. *Antennae* with the scape slender, clavate, reaching about the middle of the eye; funicle squamose, joint 1 much longer than 2 (except in *P. strigifrons*, Fls., in which they are equal). *Prothorax* variable in form, but always transverse and narrower at the apex than at the base. *Scutellum* invisible. *Sternum* with the gular margin more or less sinuate, the coxae about in the middle of the prosternum; mesepisternum usually, but not always, separated from the elytron by its epimeron; metasternum much shorter than the mid-coxae, with a more or less distinct antecoxal fold, the episternal suture complete, the episternum not produced inwardly at the base and rapidly narrowing to a point behind, the hind coxae touching the elytra. *Venter* with the intercoxal process narrower than the coxae, slightly angulate or gently rounded; hind margin of segment 1 shallowly sinuate, segment 2 much longer than 3. *Legs* with the corbels of the posterior pairs of tibiae squamose or bare, very oblique, with the upper fringe of setae ascending the dorsal edge of the tibia in a straight line, and the extreme apical edge narrowly enclosed (except in *P. sparsus* and its allies); claws connate.

In the males the elytra are narrower than in the females; the first ventral segment is very slightly impressed, and the last is shorter and more broadly rounded; in some species the legs are markedly stouter than in the females.

Genotype, *Strophosomus crucifrons*, Boh.

Distinguished from true *Strophosomus* by the setose mentum, the squamose mandibles and antennae, and the very oblique corbels of the hind tibiae.

Apart from the species here assigned to the genera *Pro-scephaladeres*, *Brachybamon*, *Pomphus*, and *Leurops*, all the African "*Strophosomus*" known to me fall within the present genus; and, judging by the descriptions, this is also likely to prove true of *S. ancorifrons*, Boh., *rotundicollis*, Boh., *crucifer*, Boh., *obsoletesignatus*, Boh., *indoctus*, Boh., *pupillatus*, Boh., *dilaticollis*, Boh., *denticollis*, Quedf., *hamaticollis*, Pér., and *concinus*, Hartm. The position of *S. hystrix*, Fst. (Ann. Soc. Ent. Belg. 1899, p. 389), from the Congo, is doubtful.

Protothoraphus immerens, sp. n.

♀. Black, with dense sandy-grey scaling; the prothorax with an ill-defined broad central brown stripe, an interrupted narrow line on each side of it, and a broad lateral stripe on the inflexed portion, the dorsal markings being sometimes absent; the elytra often with several rows of very indefinite darker spots, usually in the striae.

Head separated from the rostrum by a curved stria, which does not nearly reach the margins; the forehead smooth, the sculpturing entirely hidden by the scaling, and with a deep central furrow; the eyes prominent, strongly produced backwards, moderately convex, deepest about the middle, the hind edge of the orbit not projecting. *Rostrum* trapezoidal, much shorter than its basal width, rapidly narrowing in front, the sides straight; the upper surface flat, with only a very inconspicuous scale-covered central carina in the basal half, and the very shallow punctation hidden by the dense scaling; the genae not impressed. *Antennae* testaceous brown, with the first joint of the funicle distinctly longer and thicker than the second, which is about twice as long as the third. *Prothorax* not quite twice as broad as long (5:3), broadest at the middle, the sides moderately rounded, forming an obtuse granulated lateral edge, very deeply constricted laterally at the extreme base, and slightly emarginate on each side at the apex for the reception of the eyes; the basal margin narrowly raised, truncate and not broader than the apical, which is shallowly sinuate in the middle, the angles before the basal constriction rounded, and the apical ones almost right angles; the upper surface moderately convex transversely, but almost flat longitudinally, with fine confluent shallow punctation (hidden by scaling) and a shallow central stria, which is sometimes feebly indicated when the scaling is intact. *Elytra* oblong-ovate, almost parallel-sided from near the base to beyond the middle, jointly sinuate at the base and very broadly rounded behind; the striae very shallow, the punctures merely indicated through the scaling and each containing a minute recumbent seta; the intervals broad, slightly convex, finely rugose, and each with a row of recumbent pale setae; the scales slightly smaller than those on the prothorax, smooth, subcircular, very dense and closely contiguous. *Legs* with the front tibiae dilated at the apex and there armed with eight short stout spines, of which the innermost pair are very small and contiguous, and the outermost spine is more distant from the rest; the mid-tibiae with four

or five similar apical spines and two more slender ones on the inner surface in the apical half; corbels of the hind tibiæ with a single row of scales at the apex, the apical margin narrowly enclosed. *Sternum* with the mesepisterna separated from the base of the elytra.

Length $3\frac{3}{5}$ –4 mm., *breadth* $2\text{--}2\frac{1}{5}$ mm.

ZULULAND: Ndumu, i. 1914.

Like a small specimen of *P. amplicolis*, Fhs., to which it is very nearly related, but in that species the rostrum is more distinctly carinate, the hind margin of the orbit is produced beyond the eye, the sides of the prothorax are more explanate and much more strongly rounded, and its base is not marginate.

The adult beetles were found eating the leaves of the ground-nut (*Arachis hypogæa*). Received from the Division of Entomology, Pretoria.

Protostrophus spinicollis, sp. n. (Pl. I. fig. 5.)

♂ ♀. Colour black, the upper surface and the sternum clothed with dense pale green scales, those on the legs, venter, and the inflexed margins of the elytra being grey with a pale coppery reflexion, which colouring is also sometimes present on the head and pronotum.

Head separated from the rostrum by a deeply-curved stria, which nearly reaches the eye on each side; the forehead flattened and on a lower level than the inner edges of the orbits, rugosely punctate (concealed by the scaling), and with a broad and deep central furrow; eyes very prominent and strongly produced backwards, moderately convex, and with the greatest depth far behind the middle, the posterior edge of the orbit not projecting. *Rostrum* unusually long and narrow, distinctly longer than its basal width, sharply narrowing from the base to the middle and thence parallel-sided to the apex; the upper surface almost flat, set with coarse shallow punctures, each containing a scale, and without any furrow or carina; the genæ simply rounded, not impressed. *Antennæ* with the first funicular joint broader and much longer than the second, which is nearly twice as long as the third. *Prothorax* broader than long, the sides gradually rounded from the apex to behind the middle and there armed with a sharp backwardly-directed tooth, behind which the sides are deeply sinuated, so that the base is scarcely wider than the apex; the basal margin rounded, with a shallow sinuation in the middle, the apical margin truncate; the upper surface strongly convex transversely

and moderately so on its long axis, finely wrinkled longitudinally (the sculpture hidden by the scaling, but the ridges showing through here and there like shiny granules), and with a broad central furrow, which is almost filled by a broad, flattened, shiny, impunctate carina. *Elytra* oval, broadest about the middle, jointly sinuate at the base, with the external angles projecting forwards into a short blunt point; when the scaling is intact the striae appear narrow and very shallow, the intervals being broad, flat, and set with minute indistinct punctures (hidden by the scaling); the scales are small, almost circular, and contiguous, but not overlapping; the setae are short, dark, scale-like, and recumbent. *Legs* with the corbels of the hind tibiae bare, and the apical margin narrowly enclosed; the front tibiae without distinct apical teeth. *Sternum* with the mesepisterna broadly meeting the elytra.

Length $3\frac{1}{4}$ –4 mm., *breadth* $1\frac{3}{8}$ –2 mm.

TRANSVAAL: Naboomspruit (*D. Anderson*).

An isolated species, distinguished by its long narrow rostrum, prominent eyes, and toothed prothorax.

Received from the Division of Entomology, Pretoria, with the information that the beetles were destroying young maize-plants.

Genus *LEUROPS*, nov.

Head broad, the forehead almost flat and with a central stria which does not quite reach the vertex; eyes quite lateral, short-oval, horizontal, and only slightly convex, the curvature being unusually low as compared with allied genera. *Rostrum* a little longer than the head, strongly narrowed from base to apex, and completely continuous with the forehead; genae not dilated; epistome small, depressed, the sides not carinate, the front margin shallowly sinuate; mandibles scaly and multisetose, with a strong median tooth, the scar almost circular and not very distinct; mentum with the basal half depressed and more or less deeply sunk in its cavity, the front half with numerous setae; scrobes very narrowly visible from above and broadly dilated behind. *Antennae* with the scape slender, abruptly clavate and reaching about the middle of the eye; funicle squamose, joint 1 much longer than 2, the remainder slightly longer than broad. *Prothorax* broadest at the base, the basal margin rounded. *Scutellum* minute. *Elytra* fitting very closely to the prothorax, their sides forming very nearly a continuous line; the dorsal longitudinal curvature very flat

and almost continuous with that of the prothorax, the lateral areas very sharply inflexed and without any humeral prominence; the surface very even and scarcely striate. *Sternum* with the gular margin sinuate, the coxæ in the middle of the prosternum, and the centro-sternite not tubercular; mesepisternum not transversely impressed at the base and separated from the elytron by the mesepimeron; metasternum between the coxæ much shorter than the mid-coxæ, and with no transverse fold in front of the hind coxæ, the metepisternum continuously narrowed behind almost to a point, its base not produced internally, and the dividing suture complete; hind coxæ extremely narrowly separated from the elytra. *Venter* with the intercoxal process distinctly narrower than the hind coxæ, and its margin gently rounded; hind margin of segment 1 very shallowly sinuate, segment 2 longer than 3 or 4. *Legs* short; the corbels of the hind tibiæ oblique, squamose, and narrowly enclosed at the extreme apex, the external fringe of setæ shortly ascending the dorsal edge of the tibia; tarsal claws connate.

There are no marked external sexual characters; the first ventral segment of the ♂ is shallowly impressed, and the last one shorter than in the ♀.

Genotype, *Leurops cana*, sp. n.

The absence of the transverse stria separating the rostrum from the forehead and the comparatively slight convexity of the eyes, combined with the oblique squamose corbels of the hind tibiæ, will readily distinguish the species of this genus from their allies.

Leurops cana, sp. n. (Pl. I. fig. 1.)

♂ ♀. Colour black, the legs black to picuous; the last tarsal joint, antennæ, mentum, and part of the mandibles dark testaceous. The scaling dense, ash-grey above and below, sometimes with an admixture of pale brownish scales above, forming a very faint, broad, central stripe on the pronotum and some broken lines on the elytra; the latter usually with traces of a whitish spot about the middle of interval 5 and another behind it on interval 3.

Head quite smooth, the fine close punctation almost entirely hidden by the scaling and the short, broad, backwardly recumbent setæ; eyes very short-oval (3:2½). *Rostrum* a little shorter than its basal width, almost flat above, with a shallow central impression in the anterior half containing an indistinct longitudinal carina; the upper

edge of the scape running far below the eye. *Prothorax* perfectly smooth, the punctation and clothing as on the head, and without any central stria or carina; the basal margin not carinate, the front margin straight dorsally and hardly sinuate behind the eyes, and the sides very slightly rounded. *Elytra* very broadly ovate, the transverse dorsal curve very flat; the actual apex rapidly narrowed to a rounded point, but not visible directly from above; the basal margin jointly sinuate, embracing the base of the prothorax, but not constricted or marginate; the surface quite even, with regular rows of small separated punctures, each containing a minute seta; the intervals broad and finely coriaceous (the sculpture hidden by the scaling), and bearing irregularly placed, small, recumbent, scale-like setae, which are by no means easy to see; the suture completely hidden by the scaling.

Length 4-5 mm., breadth $2\frac{1}{2}$ -3 mm.

ORANGE FREE STATE: Bothaville (*Dr. H. Brauns*).

Described from seven specimens.

Leurops obesa, sp. n.

♂. Colour black, clothed with dense, uniform, ashy-grey scaling; the antennæ, legs, and part of the mandibles piceous.

Very closely allied to the genotype, but differing as follows:—*Head* with the eyes more nearly circular ($3\frac{1}{4}$:3). *Rostrum* distinctly longer, a little longer than its basal width; the upper edge of the scrobe, if continued, would touch the lower margin of the eye, whereas in *L. cana* it would pass far below the eye; the scrobe itself distinctly shallower behind. *Prothorax* proportionately longer, with the front margin more deeply sinuate behind the eye.

Length 5 mm., breadth 3 mm.

INTERIOR OF S. AFRICA.

Described from a single male.

Leurops substriata, sp. n.

♂ ♀. Colour black, with dense scaling; the legs and antennæ piceous black. In a well-marked specimen the pattern is as follows:—Ground-colour pale grey; the upper-side of the head and rostrum light brown, except the apex of the latter and a bisinuate transverse line at its base, a central line on the forehead and a stripe above each eye,

which are grey; prothorax with a broad, dark brown, median stripe, a less distinct one on each side of it, and a narrower one on the inflexed sides; elytra with the suture narrowly light brown, and with dark brown macular stripes covering striae 1, 2, 5, and the base of 4. But some or all of these markings may be very nearly obliterated.

Also very close structurally to *L. cana*, but the eyes are decidedly more convex, and the central stria on the forehead is more concealed by the scaling; the rostrum is even shorter in proportion to its basal width, and the central carina is more raised at its base; the setae on the head and rostrum are longer and distinctly raised, whereas in *L. cana* they lie quite flat; the setae on the pronotum and elytra are similarly longer and much more conspicuous; the prothorax has the basal margin narrowly carinate and less strongly rounded; the scutellum is smaller, being scarcely perceptible; the elytra bear very shallow striae (of which there is no trace in the other two species), and when abraded the punctures appear appreciably larger and more closely set.

Length 5-6 mm., breadth $3-3\frac{1}{4}$ mm.

ORANGE FREE STATE: Paul Roux, 23. x. 1917 (*M. G. Ferreira*).

Described from one male and four females; received from the Division of Entomology, Pretoria, with a record that the insects were injuring maize-plants.

Genus PSEUDOBLOSYPUS, nov.

Head twice as broad as long, trisculate, the eyes very prominent. - *Rostrum* subquadrate, separated from the head by a deep sinuous furrow that reaches the sides, the lower surface with two deep longitudinal furrows and a transverse basal impression; epistome well defined, the sides forming an obtuse ridge, rounded behind, the front margin deeply sinuate and shorter than one of the sides; mandibles multisetose and without scaling, with a distinct median tooth and a sharp longitudinal carina running from the scar to the base; mentum with the anterior part convex and bearing a fringe of setae, the posterior part flat and deeply sunk in its cavity; scrobes entirely lateral and quite invisible from above, very deep and gradually widening outwardly, the upper edge ending on a level with the lower margin of the eye. *Antennae* with the scape gradually clavate and reaching the middle of the eye; funicle squamose, the two basal joints

of equal length. *Prothorax* transverse, the basal margin finely carinate. *Scutellum* concealed. *Elytra* subglobose, fitting closely to the prothorax, with a subhumeral prominence and irregular punctation. *Sternum* with the gular margin shallowly sinuate, the coxæ in the middle of the prosternum, the centro-sternite small and tubercular; mesepisterna narrowly separated from the elytra and with a transverse furrow at their extreme base (often hidden by the prosternum); metasternum between the coxæ distinctly shorter than the mid-coxæ and with a strong antecoxal fold, the episternum angularly produced inwards at the base, the episternal suture more or less obliterated at its apex; the hind coxæ narrowly separated from the elytra. *Venter* with the intercoxal process strongly angulated, and nearly as broad as the hind coxæ; segment 1 with a small sinuation in the middle of the hind margin, segments 2-4 subequal in length. *Legs* comparatively slender, the femora only slightly clavate; all the tibiæ with a row of five to seven stout spines along the inner edge of the apical half, the hind tibiæ with the corbels obliquely terminal, bare and distinctly enclosed; claws connate.

♂. The last ventral segment bears a large deep impression. Genotype, *Pseudoblosyrus sharpi*, sp. n.

Superficially just like a *Blosyrus*, but distinguished by the setose mentum, the enclosed corbels of the hind tibiæ, the angulated base of the metepisternum, and the irregularly foveate and tuberculate elytra.

Pseudoblosyrus sharpi, sp. n. (Pl. I. fig. 2).

♂ ♀. Black, not very shiny, with sparse grey scaling on the elytra and pale bluish scales on the head and pronotum.

Head with fine shallow punctation, the lateral sulci almost as deep as the central one; eyes hardly produced backwards, their greatest depth well behind the middle, the hind edge of the orbit not projecting. *Rostrum* longer than the head, about as long as broad, almost parallel-sided, somewhat flattened above, with a strong complete central costa, which bifurcates near the apex; adjoining the costa on each side a broad, deep, oblique impression, the punctation coarse, but very shallow. *Antennæ* with joints 4-6 of the funicle subequal, bead-like, a little longer than broad, and shorter than 3 and 7, which are nearly equal. *Prothorax* with the sides rather strongly rounded, broadest before the middle, the apical margin truncate, narrower than the base and quite

vertical laterally, the basal margin arcuate; the upper surface coarsely coriaceous, with a broad oblong median impression, the dorsal outline sloping from base to apex. *Elytra* subglobose, broadest before the middle, the dorsal outline strongly convex, deepest before the middle, the base sinuate and slightly raised laterally, the apices jointly rounded; set with shallow, irregular, more or less confluent and ill-defined foveæ, only the juxta-sutural row and those on the inflexed sides being regular; the intervals with numerous irregular, large, low, rounded tubercles, which are bare and closely and finely punctate; the small broad curved setæ are with difficulty distinguishable from the true scales.

Length 10-11 mm., breadth $5\frac{1}{2}$ -6 mm.

TRANSVAAL: Pretoria.

Types, ♂ in Dr. D. Sharp's collection, ♀ in the British Museum.

Described from 1 ♂ and 6 ♀ ♀, all of which were kindly submitted to me by Dr. Sharp, who had already recognized that in spite of its superficial resemblance to *Blosyrus* this species is really more closely allied to the Madagascar genus *Holonychus*.

Genus SYNECHOPS, nov.

Head with a central furrow which does not reach the vertex, not constricted behind the eyes, which are quite lateral and very convex. *Rostrum* strongly deflected, continuous with the forehead, oblong, the dorsal edges broadly rounded off, the lower surface parallel with the upper; epistome quite indefinite posteriorly, the apical edge deeply emarginate; mandibles multisetose, not squamose, without any median tooth or dorsal longitudinal carina, the scar subtriangular; mentum setose; scrobes narrow, deep, and squamose, the upper edge ending on a level with the lower margin of the eye, the apical portion partly visible from above. *Antennæ* with the scape rather abruptly clavate, reaching about the middle of the eye; funicle squamose, the two basal joints equal. *Prothorax* transverse, narrower in front than behind. *Scutellum* small, but distinct. *Elytra* fitting closely to the prothorax, the base not marginate, the apices jointly rounded, the shoulders rounded, the punctuation irregular. *Sternum* with the gular margin truncate, the coxæ in the middle of the prosternum, the centro-sternite tubercular; mesepisterna meeting the elytra only at the

extreme base; metasternum shorter than the mid-coxæ, with a distinct antecoxal fold, the episternum produced inwards at the base, the episternal suture visible only in the basal half, the hind coxæ meeting the elytra. *Venter* with the intercoxal process angulated and narrower than the hind coxæ, the hind margin of segment 1 sinuate, and segment 2 longer than 3 and 4 together. *Legs* with the femora moderately clavate; tibiæ straight and cylindrical, not mucronate at the apex, the hind corbels open and bare; tarsi broad, the claws connate.

♂ unknown.

Genotype, *Synechops irregularis*, sp. n.

A rather isolated genus, readily distinguished by the following combination of characters: the complete absence of any dividing-line between the rostrum and forehead, the open corbels of the hind tibiæ, and the simple mandibles.

Synechops irregularis, sp. n. (Pl. I. fig. 8.)

♀. Black, with uniform, dense, sand-coloured scaling.

Head rather strongly convex transversely, shallowly impressed on each side behind the eyes, the long scale-like setæ quite recumbent; eyes nearly circular and hemispherical. *Rostrum* stout, parallel-sided, almost flat above, but with the dorsal edges gradually rounded away, with coarse confluent punctation (mostly hidden by scaling) and with a central furrow (continuous with that on the head) from the base to the middle. *Antennæ* with joints 3-7 of almost equal length, but 7 distinctly broader than the others, trapezoidal. *Prothorax* broader than long ($2\frac{1}{2} \times 2$), the sides moderately rounded, broadest a little before the middle, with a very shallow transverse impression at about one-fourth from the apex, the basal margin very gently arcuate and not raised, the apex truncate; the upper surface with coarse confluent punctation (mostly hidden by the scaling and stout recumbent setæ) and no central furrow or carina, but with some irregular impressions on each side behind the middle; the dorsal outline almost level, forming a continuous curve with that of the rostrum and head. *Elytra* oblong-ovate, rather broadly rounded behind (as seen directly from above), the basal margin gently sinuate; the dorsal outline rising from the scutellum, then almost flat, and sloping steeply behind, the apical part quite vertical; the punctation coarse and quite irregular, except for a row

along the suture and two or three on the inflexed sides; the spaces between the punctures, where visible, shining and coriaceous; the scales small, nearly circular, convex, and shiny; the stout flattened setæ irregularly placed and nearly recumbent.

Length $8\frac{1}{2}$ mm., breadth $4\frac{1}{4}$ mm.

CAPE COLONY: Hex River.

Described from a single specimen.

Genus CYCHROTONUS, Pasc.*.

As a result of following Faust's interpretation of the genus *Chaunoderus*, Gerst., I sank *Cychrotonus* as a synonym of it (Proc. Zool. Soc. 1906, p. 958). It is now clear that under *Chaunoderus* Faust associated insects having two distinct types of antennal scrobes. In the genotype, *C. stupidus*, Gerst., with which I am not acquainted, the scrobes are described as being of a normal Otiorrhynchine type—superior, directed straight towards the eyes, and disappearing a little before the middle of the rostrum; whereas in *Cychrotonus* they curve downwards in front of the eye and extend to the base of the rostrum. Of the described species of *Chaunoderus* known to me, the following must be referred to *Cychrotonus*:—*C. marginalis*, Fst., *C. subglaber*, Fst., *C. sternalis*, Hartm., and *C. apicalis*, Hartm.; whereas *C. brevicollis*, Fst., and *C. transversus*, Fst., may provisionally remain in Gerstaecker's genus.

Cychrotonus ellipticus, sp. n. (Pl. I. fig. 7.)

♂ ♀. Black or piccons, practically devoid of scaling above; the lower surface of the head and rostrum, the sternum, and coxæ with scattered, flat, bluish scales; the venter with numerous elongate, narrow, curved, whitish scales.

Head with rather coarse, longitudinally confluent punctation, the forehead flat, but not noticeably depressed below the vertex; eyes rather less convex than usual, deepest in the middle and bounded internally by a deep furrow.

Rostrum longer than broad, rather broader near the base than at the genæ, the sides sinuate in the middle; coarsely

* Journ. Linn. Soc., Zool. xi. 1871, p. 162.

punctate, with a low broad central carina (sometimes rather ill-defined) and a narrower curved one on each side of it; set with brownish curved scale-like setæ, and sometimes with some narrow bluish scales on the apical half; scrobes with the upper margin sharply angulate close to the base. *Antennæ* with the scape distinctly curved, the funicle with joint 1 hardly longer than 2, 3-7 subequal, bead-like, and slightly broader than long. *Prothorax* broader than long (3:2), broadest at the base, strongly narrowed in front, the sides rounded, the apical angles very prominent (as seen from above), the dorsal apical margin truncate, the basal margin arcuate; the dorsal outline strongly convex transversely and slightly so longitudinally, the apex being much below the level of the base; the upper surface strongly and very closely punctate, with a faint longitudinal impression in the middle of the base, the sculpture on the inflexed sides becoming more or less plicate; the lateral portion of the apical margin carinately raised, forming an obtuse angle below the eye and a sharp projection in front of each coxa. *Scutellum* closely punctate. *Elytra* narrowly elliptical and broadest before the middle in ♂, rather broader in ♀, which has the humeral angulation scarcely perceptible, the basal margin jointly sinuate; the elytra strongly compressed behind, so that the suture is elevated on the declivity, the longitudinal outline almost flat in ♂, the apical portion dropping almost at a right angle and sinuate in profile; in the ♀ the outline slopes more from the middle to the top of the declivity; the shallow striæ with large quadrate punctures, the intervals about as broad as the striæ, finely punctate and somewhat rugulose transversely, with scattered, extremely minute, scale-like setæ, which are conspicuous only on the declivity. *Sternum*: mesosternum with a perfectly smooth shiny patch adjoining the outer sides of the mid-coxæ and standing out in contrast with the strongly sculptured surface; metasternum sparsely granulate. *Venter* very rugosely punctate and granulate, especially in the ♂, in which the first segment bears behind the coxa a deep excision, the portion between it and the elytra being smooth and shiny.

Length, ♂ $11\frac{1}{2}$ -13 mm., ♀ $10\frac{1}{2}$ mm.; breadth, ♂ $4\frac{1}{2}$ - $5\frac{1}{2}$ mm., ♀ $4\frac{1}{2}$ mm.

BELGIAN CONGO: Kasenga, xi. 1912 (*Dr. Bequaert*).

This distinct species is specially characterised by its elongate shape, the two sharp prominences on the gular

margin of the prosternum, and the remarkable structure of the first ventral segment of the ♂.

Described from 2 ♂ ♂ and 1 ♀.

Cychrotonus decoratus, sp. n.

♂ ♀. Black or piceous, with inconspicuous and easily abraded dark scaling on the disk of the elytra, and with the following markings formed of pale metallic-green scales:—A stripe along the inner edge of each eye and the whole side of the head and rostrum; a narrow median stripe on the prothorax, a broader lateral one behind the eye, and another above the coxa; elytra with a stripe on interval 1 from behind the scutellum to about the middle, a short humeral stripe on 7 from the base to about one-third, a complete marginal stripe reaching stria 9, but broader at the apex and emitting at the middle a more or less dentate broad oblique band, which reaches the suture at the top of the declivity and is united by a sutural stripe to the apical patch; a very short isolated stripe at the apex of interval 5, and occasionally a still shorter one at the apex of 7; in the ♀ only there is a round spot at the middle of interval 3 and a trace of another on 5. The lower surface rather thinly clothed with pale greenish scales.

Head with strong, longitudinally confluent punctation, a deeply impressed line along the inner margin of the eye, and a large central fovea; eyes rather less prominent than usual, deepest in the middle. *Rostrum* a little longer than broad (7:6), parallel-sided, almost flat on the disk, coarsely and confluent punctate, with a low smooth median costa (rather broader and flatter in the ♀) which widens anteriorly, a low punctate costa forming the margin of the dorsal area, and beneath it a longitudinal impression in front of the eye. *Antennae* with the two basal joints of the funicle equal, joints 3–7 subequal and about as long as broad, the first joint of the club narrow and subcylindrical in its basal half. *Prothorax* about as long as the apical width, the sides subparallel from the base to the middle, then gradually narrowed to the apex, the apical margin broadly sinuate (as seen from above) owing to a marked thickening behind the eye, the base very shallowly bisinuate, the longitudinal outline nearly flat; the upper surface with close shallow punctures of varying sizes, each filled with a flat scale, the median line often very shallowly impressed in the basal half. *Elytra* narrowly

ovate in the ♂, broader in the ♀, broadest before the middle, with barely a trace of a humeral prominence in the ♀, the basal margin jointly sinuate; the shallow striae with large separated punctures; the intervals broad and with fine shallow punctation. *Sternum* rugose, but not granulate, except the mesosternum, which is finely aciculate. *Venter* with two oblique impressions on segment 1 behind the coxa in the ♂ only.

Length 8–10 mm., breadth $3\frac{1}{4}$ – $4\frac{1}{4}$ mm.

BELGIAN CONGO: Lukombe, x. 1908 (*A. Koller*).

Described from 3 ♂♂ and 3 ♀♀.

Easily distinguished from all the other known species of the genus by its striking coloration.

EXPLANATION OF PLATE I.

Fig. 1. Lewrops cana, sp. n., p. 19.

Fig. 2. Pseudoblosyus sharpi, sp. n., p. 22.

Fig. 3. Pomphus denticollis, sp. n., p. 8.

Fig. 4. Proscopus marginatus, sp. n., p. 13.

Fig. 5. Protostrophus spinicollis, sp. n., p. 17.

Fig. 6. Bradyhamon swalei, sp. n., p. 10.

Fig. 7. Cybrotanus ellipticus, sp. n., ♂, p. 25.

Fig. 8. Symechops irregularis, sp. n., p. 24.

II.—On *Lacerta praticola*, *Eversm.* By L. A. LANTZ and O. CYRÉN.

BOETTGER remarks, in his account of the reptiles collected in the Talysh by G. Radde and H. Leder*, that the two specimens of *Lacerta praticola* examined by him differ from Western Caucasian specimens in having five pairs of chin-shields instead of six, two instead of three forming a median suture. The author thinks it would be possible to establish a local variety, should this character be found to be constant.

This is indeed the case, as appears from our examination of a larger material collected in the same country. We found only isolated specimens—from the Talysh † as well as from the Western Caucasus ‡—with five chin-shields on

* Radde, 'Fauna u. Flora d. südwestl. Caspischebietes,' Leipzig, 1886, p. 37.

† One specimen out of 21.

‡ One specimen out of 43.

one side and six on the other; in such case the median suture is formed by two shields on one side and three on the other. As the two forms differ also in other characters, such anomalous specimens can, however, easily be identified; therefore the separation of *L. praticola* into two subspecies seems to be justified.

Eversmann's description and figure of the type-specimen from Piatigorsk* are not clear enough to settle the question, which of the two subspecies must be considered as the typical. A full description of the species was first given by Kessler†, who examined thirteen specimens from the Kuban district, Piatigorsk, valley of R. Bielaja, and Ananur, two of which formerly were in Eversmann's collection. Kessler indicates six pairs of chin-shields, the first three forming a median suture. Relying on this, we intended to describe a Caspian subspecies, believing the Western Caucasian form to be the typical one.

Thanks to the kindness of MM. K. Derjugin and P. Nesterov we have been enabled to revise the collection of the Petrograd University. We found there several of Kessler's specimens, and amongst them one labelled "Piatigorsk, leg. Eversmann." We must admit that Kessler neglected to examine the chin-shields of this very specimen, as it has only five pairs of them and agrees in every* respect with the Talysh *L. praticola*. It cannot, however, be considered as the type-specimen, because it has a normal interparietal and occipital, while Eversmann indicates these shields as separated by an accessory one.

Both the type-specimen and the specimen preserved in the Petrograd University are from the same locality; other material from Piatigorsk, Essentuki, and Kislovodsk‡ was kindly examined for us by M. S. Tsarevski. All these show only five pairs of chin-shields, two of them forming a median suture. Therefore it is undeniably the Oriental subspecies which occurs at Piatigorsk and surrounding localities that must be considered as the typical *L. praticola*.

It is of great interest that *L. praticola praticola* seems to be confined to the Caspian Sea basin§, while the western

* *Lacerte Imperii Rossici* (Moscow, 1834).

† Journey in Transcaucasia, St. Petersburg, 1878, p. 156 (in Russian).

‡ Coll. Acad. Petr. Nos. 5273, 6861, and 7900.

§ We examined specimens from Piatigorsk, Mount Il near Vladikavkaz, Lagodekhi, Kala-Dagna, valley of R. Astara-tshai, Elburz mountains between Astara and Ardebil, Shafe-rud near Enzeli.

subspecies is found practically only in countries draining towards the Black Sea*—a fact which induced us to choose for the latter the name *pontica*. Judging from several specimens from Mehadia†, the Hungarian *L. praticola* also belongs to this form.

The two subspecies may be distinguished by the following characters :—

1. *Lacerta praticola praticola*, Eversm.

Head and limbs comparatively short. Proportion, $\frac{\text{length of pileus}}{\text{length of head and body}}$: 0.22–0.23–0.24‡ in the ♂ (8 spec.) and 0.18–0.20–0.23 in the ♀ (10 spec.). Proportion, $\frac{\text{length of fore limb}}{\text{length of head and body}}$: 0.30–0.31–0.33 in the ♂ (8 spec.) and 0.26–0.28–0.33 in the ♀ (10 spec.). Proportion, $\frac{\text{length of hind limb}}{\text{length of head and body}}$: 0.45–0.48–0.52 in the ♂ (8 spec.) and 0.39–0.43–0.49 in the ♀ (10 spec.).

Row of *superciliary granules* incomplete and generally reduced to a few granules. Occipital generally very small, narrower than, or as broad as, the interparietal, and penetrating only a little between the parietals. Always a single *postnasal*, in contact with the internasal. *Masseteric shield* moderate, rarely reaching the first supratemporal, and separated from the tympanic by 2, seldom by 1 or 3, rows of rather small temporals. 5, seldom 6, *lower labials*. 5 pairs of *chin-shields*, the first 2 forming a median suture. On a line between the suture of the chin-shields and the collar 16–19–22 *gular scales* (21 spec.). *Dorsal scales* comparatively broad and short, rather feebly keeled, and imbricate; in a transverse row across the middle of the body 35–39–43 scales (19 spec.). In the ♂ 26–26–27 (8 spec.), in the ♀ 28–29–30 (10 spec.), transverse rows of ventral plates.

2. *Lacerta praticola pontica*, subsp. n.

Head and limbs comparatively long. Proportion, $\frac{\text{length of pileus}}{\text{length of head and body}}$: 0.23–0.24–0.24 in the ♂ (16 spec.)

* The specimens examined are from Georgievsko-Osetinskoie (Kuban Valley), Novorossiisk, Sotshi, mountains near Adler, Gagry, Gudaut, Sukhum, Ananur (valley of R. Aragva); the latter locality only belongs to the Caspian Sea basin.

† Coll. Acad. Petr. No. 9814.

‡ The middle number means the average.

and 0.20-0.21-0.21 in the ♀ (12 spec.). Proportion,
 $\frac{\text{length of fore limb}}{\text{length of head and body}}$: 0.28-0.33-0.34 in the ♂ (16 spec.)
 and 0.26-0.29-0.31 in the ♀ (12 spec.). Proportion,
 $\frac{\text{length of hind limb}}{\text{length of head and body}}$: 0.47-0.51-0.54 in the ♂ (16 spec.)
 and 0.40-0.45-0.49 in the ♀ (12 spec.).

Row of *superciliary granules* generally not much reduced, often complete. *Occipital* comparatively large, generally broader than the interparietal, and penetrating rather widely between the parietals. *Postnasal* generally not reaching the internasal; sometimes two superposed postnasals, the upper small, in contact with the internasal. *Masseteric shield* large or very large, almost always in contact with the first supratemporal, and separated from the tympanic by one large scale or two superposed rather large temporals. 6, seldom 7, *lower labials*. 6 pairs of *chin-shields*, the first 3 forming a median suture. On a line between the suture of chin-shields and the collar, 14-17-19 *gular scales* (43 spec.). *Dorsal scales* comparatively narrow and elongate, rather strongly keeled, and imbricate; in a transverse row across the middle of the body 32-37-41 scales (43 spec.). In the ♂ 22-25-26 (23 spec.), in the ♀ 26-28-30 (18 spec.), transverse rows of *ventral plates*.

In reading the description of *L. vivipara stenolepis*, Nik.*, we could not find any character to separate this form from *L. praticola*. This was confirmed on examining the type-specimen, a very large ♀ † offering the anomaly mentioned above, i. e. 5-6 chin-shields. By the other characters of scaling, and especially the rather small masseteric shield, the number of superciliary granules reduced to 3 on each side, it appears as a well-characterized *L. praticola praticola*, which cannot be confounded with *L. vivipara*.

Recently Nikolski described a new species from Sotski, *L. colchica* ‡, which seems also to be closely allied to *L. praticola*. The author was so kind as to send us the type-specimen for closer examination. It is a typical *L. vivipara*, Jacq., entirely agreeing with some specimens from the Government of Moscow used for comparison. *L. vivipara* has never been recorded from Transcaucasia, and it is very doubtful that it occurs in that country; probably some error has taken place in labelling this specimen.

* 'Herpetologia caucasica,' Tiflis, 1913, p. 54.

† Coll. Acad. Petr. No. 7203, from Mount Il near Vladikavkaz.

‡ 'Fauna of Russia, Reptiles,' i. (Petrograd, 1915).

III.—*The White-toothed Shrew of Palestine.*

By OLDFIELD THOMAS.

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CAPT. G. C. SHORTRIDGE has contributed to the British Museum a couple of specimens of a white-toothed shrew obtained by him during the Palestine campaign.

It appears to represent a new subspecies of *Crocidura russula*, and may be called

Crocidura russula judaica, subsp. n.

Like the large Central European *C. russula russula*, but colour paler and greyer.

Fur of back about 4.2 mm. in length; very few longer piles present.

General colour of upper surface rather darker than "light drab," much brighter, greyer, and less brown than true *russula*, owing to the reduction of the dark brown tips to the hairs and the greater degree to which the grey of the underfur shows through. Under surface distinctly lighter, the ends of the hairs whitish, with but little drabby suffusion. Tail rather short.

Skull as in *C. r. russula*. Third upper unicuspid rather broader than second.

Dimensions of the type (taken from skin):—

Tail 37 mm.; hind foot 13.

Of a specimen measured in the flesh:—

Head and body 58 mm.; tail 38; hind foot 13; ear 9.5.

Skull (of type): condylo-incisive length 21.2; greatest breadth 9.5; height of crown from basion 4.7; upper tooth-row 9.7.

Hab. Palestine. Type from near Jerusalem.

Type. Adult male. B.M. no. 18. 8. 1. 3. Collected April 1918, and presented by Capt. G. C. Shortridge. Two specimens.

While the other forms of the *russula* group described from S.W. Asia are darker than the typical European animal, the present one is readily distinguishable from all by being markedly lighter.

IV.—On the Structure of the Larvæ and the Systematic Position of the Genera *Mycetobia*, Mg., *Ditomyia*, Winn., and *Symmerus*, Walk. (*Diptera Nematocera*). By D. KEILIN, D.Sc. (from the Quick Laboratory, University of Cambridge).

[Plates II.—V.]

I. *Mycetobia pallipes*, Meigen.

The larvæ of *Mycetobia pallipes* were first described and figured by Lyonnet (1832) and Guérin-Ménville (1835).

Dufour (1841) and notably Perris (1870), after a more complete study of these larvæ, showed that their respiratory system is amphipneustic and called attention to their external resemblance to the larvæ of *Rhyphus fenestralis*, Scop.

Osten-Sacken (1892), referring to the papers of these entomologists, again raised the question of the larval resemblance of *Mycetobia* and *Rhyphus*, which in the adult stage seemed to be so different. But since Osten-Sacken the majority of entomologists dealing with *Mycetobia* unquestioningly referred this genus to the family Mycetophilidæ, passing over in silence the peculiar structure of its larvæ. Those who gave the matter any attention either doubted the correctness of the original observations of Dufour and Perris, or did not admit the value of larval characters in determining the systematic position of Insects.

However, a study of the life-history and larval morphology of *Mycetobia pallipes*, Mg., and *Rhyphus fenestralis*, which I carried out in 1912-13 on material collected at Chaville (near Paris) has led me to the conclusion that the resemblance between these larvæ and their difference from those of Mycetophilidæ is much deeper than was ever supposed.

In the present paper I will point out only the main characters common to the early stages of *Mycetobia pallipes* and *Rhyphus fenestralis*, but not found in those of Mycetophilidæ.

A more detailed study of the larval anatomy of *Mycetobia* I propose to reserve for a special paper dealing with the family Rhyphidæ.

Characters common to *Mycetobia pallipes* (Pl. II. fig. 2, Pl. V. figs. 36, 37, 38) and *Rhyphus fenestralis* (Pl. II. fig. 1).

1. The eggs are invested with a gelatinous mass which is fixed to a solid substratum.
2. Eggs are pear-shaped.

Characters common to all the Mycetophilidæ (Pl. III.) except the genera *Ditomyia* and *Symmerus*.

1. Eggs are more or less scattered on the surface of the fungus or rotten wood.
2. Eggs are elongated or sub-spherical.

3. Embryo in the egg curved.
4. The larvæ move in a serpentine manner, or by means of very active mandibles.
5. The segments of the body are separated by intercalary rings (Pl. V. fig. 38).
6. The larval head with a pair of tentorial rods (Pl. II. figs. 1 & 2, *t.n.*) similar to those of the larvæ of *Trichocera*.
7. Antennæ with a special sensory organ (Pl. V. fig. 37, *b.s.*), corresponding to the bell-shaped papilla of many other dipterous larvæ (for instance, those of *Ditomyia* and all cyclorhaphous Diptera) and with some small cylindrical papillæ.
8. Mandibles (Pl. V. figs. 35 & 36) show two distinct portions: basal portion (*b.p.*) with an internal hook (*h.*), and terminal or apical portion (*t.p.*) which is more chitinised, ending in three teeth and bearing two brushes of brown setæ.
9. Maxillæ fleshy and soft; the maxillary palp (figs. 1 & 2, *m.p.*) broad, thick, transparent, bearing two groups of sensory papillæ (*a.* and *b.*); the internal part of the maxillæ (*m.x.*), besides a few sensory organs, bears numerous long setæ.
10. Labrum with two mid-ventral protuberances covered with hairs (figs. 1 & 2, *l.r.* & *p.r.*) and a small comb-shaped plate (*c.m.*) on each side of posterior protuberance.
11. Labium well developed and with distinct labial palps (*l.p.*).
12. The thoracic sensory organs which are the remains of the thoracic legs are composed of four hairs (two long and two short).
3. Embryo straight.
4. The larval movements are worm-like.
5. No distinct intercalary rings (Pl. III. fig. 3); only some larvæ—for instance, those of *Ceroplastus*—have the segmentation of their abdomen masked by superadded transverse folds.
6. Head without tentorial rods.
7. Antennæ either elongated as in *Bolitophila* (Pl. III. fig. 4, *A.n.*, and fig. 13) or reduced to a flat, wide, non-chitinised surface bearing some very small sensory papillæ.
8. Mandibles (figs. 5 & 7) flattened, strongly chitinised, and with their internal margin toothed.
9. Maxillæ (Pl. III. figs. 10, 11, 12) flattened and strongly chitinised, with their internal margin (*m.x.*) toothed, like those of the mandibles. The maxillary palps (*m.p.*) are very much reduced.
10. Labrum (figs. 6 & 8) without mid-ventral protuberances and without comb-shaped plates.
11. Labium reduced and not visible from exterior.
12. Thoracic sensory organs composed of four hairs of equal length (fig. 9).

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| <p>3. Respiratory system is amphipneustic with only two pairs of functional spiracles: (1) prothoracic and (2) postabdominal.</p> <p>14. Alimentary duct without anterior cœca.</p> <p>15. Anus ventral.</p> <p>16. Salivary glands short.</p> <p>17. Hypoderm of posterior segments of larvæ, which surrounds the anal cleft, is composed of very large and thick cells.</p> <p>18. Pupæ strongly chitinated with rows of small hooks on the abdominal segments and especially on the posterior end of their body.</p> | <p>13. Respiratory system is either hemipneustic (fig. 3) with one pair of prothoracic and seven pairs of abdominal spiracles, or propneustic (<i>Polypleta</i> or <i>Diadocidia</i>), or apneustic (<i>Ceroplastus</i>).</p> <p>14. Alimentary duct with a pair of anterior lateral cœca.</p> <p>15. Anus terminal or subterminal.</p> <p>16. Salivary glands very long.</p> <p>17. No special large cells in hypoderm of the posterior end of the body.</p> <p>18. Pupæ with thin chitin and without the rows of short spines or hooks.</p> |
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All these characters show us clearly that the difference between the larva of *Mycetobia* and those of *Mycetophilidæ* (s. l.) is as striking as its resemblance to the larvæ of *Rhyphidæ*.

But to solve finally this question a comparative study of the adult stages of these Diptera had to be undertaken, and this was done by F. W. Edwards (1916, p. 115), who in his interesting paper "On the Systematic Position of the Genus *Mycetobia*, Mg.," arrived at the following conclusion:—

"*Mycetobia* agrees with the *Rhyphidæ* and diverges from the *Mycetophilidæ* in the possession of a large gular plate, in the structure of the second palpal joint, in the position of the forking of the radial vein, the course of the cubital vein, and in the chitinous spermathecae of the female. Since the venation of *Mycetobia* has been shown to be directly derivable from that of the *Rhyphid* genus *Olbogaster*, it is probable that any resemblances in this respect to the *Mycetophilidæ* are due to convergent evolution, and not to relationship. The genus *Mycetobia* (and with it *Mesochria*, though not *Ditomyia* or *Symmerus*) must therefore, on grounds of adult as well as larval structure, be transferred from the *Mycetophilidæ* to the *Rhyphidæ*."

II. *Ditomyia fuscata*, Meig.

The first indication of the habitat of this species we owe

to Meigen (1818, t. i. p. 230), who found a young undeveloped male of this fly in *Polyporus versicolor*.

Zetterstedt (1851, t. x. p. 4071) quotes Behrens, who bred this insect from a fungus which he found on *Juglans regia*.

According to Winnertz (1863, p. 669), the larvæ of *D. fasciata* live in different *Polyporus* and especially in *P. versicolor* and *ferrugineus*; he quotes also Kaltenbach who bred *D. macroptera*, Winnertz, from *Polyporus ignarius*.

Schiner (1864, i. p. 428) reared *D. fasciata* from various *Polypori*.

Frauenfeld (1866, p. 200) found the larvæ of this species in *Polyporus squamosus*; he also gave the first description of the larval and pupal stages of this fly. Unfortunately, his very short description does not contain any figure, and may be applied to many other dipterous larvæ. The only characters of his description worth mentioning are the following: (1) the intersegmental spaces are deeply constricted, (2) the first segment of the thorax is large, and (3) the posterior end of the body bears two protuberances ended by a sharp spine.

We have, finally, to mention that the collection in the Entomological Museum of Cambridge contains the pupæ and adults of *Ditomyia fasciata*, Mg., reared by Fryer (1910) from *Polystictus versicolor* collected at Chatteris (Cambs) and by H. Scott (1910) from the same fungus collected from beech-stumps at Henley-on-Thames.

I received the larvæ and pupæ of *Ditomyia fasciata*, which will be described here, from Mr. F. W. Edwards, who found them in a fungus, which he believes to be *Polystictus versicolor*, growing on old beech-stumps near Cambridge and at Baldock, Herts.

Later on, I collected myself a few of these larvæ in a piece of wood covered and penetrated by the mycelium of a fungus.

According to Edwards, in nature the larvæ usually live upon the old fungi, but in his breeding-jars he observed them attacking the fresh fungi also.

The larvæ are opaque white in colour and have very little power of movement. Pupation takes place within the fungus without the formation of any cocoon; before the emergence of the adult the pupa bores its way to the surface and comes halfway out.

The larva is 9·3 mm. long, with very deep intersegmental grooves (Pl. IV. fig. 14).

The head of the larva is completely free, though it may be retracted in the first thoracic segment. The antennæ (Pl. IV. fig. 23) are very small and consist of a short basilar segment which bears sensory organs of three different shapes: (1) the main bell-shaped (*b.s.*) sensory organ which is very common in dipterous larvæ, (2) one bi-articulated papilla (*p.*), and (3) five short cylindrical papillæ.

The labrum (fig. 15) shows on its anterior margin a brush composed of ordinary setæ mixed with sensory hairs. On each of its latero-anterior corners it bears a bidental chitinous plate (*d.*), and on its ventral side a series of short spines and scales and two strongly chitinised plates (*p.l.*).

The mandibles (fig. 22) are very well developed, thick, and of a dark brown chitin; their external margin is slightly cut into four teeth; they bear three lateral sensory hairs and a brush of ordinary brown setæ which originates from the internal basilar corner of the mandibles.

The maxillæ (fig. 17). The basal part or cardo of the maxillæ consists of soft and transparent chitin with a transverse brown band (*t.b.*) and a sensory organ in the form of a small circular groove. The internal part of the maxillæ (*m.x.*) is conical in shape and bears a long sensory hair (*s.h.*). The maxillary palp (*m.p.*) is very well developed and furnished with a series of sensory organs and some ordinary chitinous setæ.

The labium consists of a short chitinous plate terminating in two tridental processes. On the ventral side it bears two hemispherical palps (*l.p.*) of transparent chitin, each with three sensory papillæ.

The thorax is composed of three large segments furnished with a series of sensory hairs. Among the latter we may mention six groups of three hairs (fig. 19) which represent the remains of the thoracic legs. As I have previously shown (1911, 1915) these six groups of sensory organs exist in all dipterous larvæ and are always in direct connection with imaginal discs of the thoracic legs.

The eight abdominal segments bear also a series of sensory hairs, and on their ventral side they are furnished with lozenge-shaped projections or pseudopodia covered with very short setæ. The last abdominal segment differs from all the others in bearing the anus and a pair of dorsal projections terminated by spiracles.

The respiratory system of this larvæ is peripneustic, *i. e.* it is composed of nine pairs of functional spiracles (one pro-

thoracic and eight abdominal), and one pair of metathoracic non-functional spiracles connected with the main tracheal trunks by means of simple chitinous bands.

All the functional spiracles, except the last abdominal, are circular, with numerous trema surrounding a central chitinous plate which corresponds to the cork-shaped scar ("Bouchon cicatriciel") of the spiracles of *Trichocera*, Tipulid or Bibionid larvæ. The prothoracic spiracle (fig. 21) is much larger in size than any of the first seven pairs of abdominal spiracles (fig. 18).

The posterior abdominal spiracles (fig. 20, *s.p.*), which are situated on the dorsal projections of the last abdominal segment, are elongated and spine-shaped. The surface of their external scar (*s.c.*) is covered with very small chitinous hooks.

Alimentary canal (fig. 16). The very short pharynx is enclosed in the larval head. It is followed by a short œsophagus (*œ.e.*) which enters the proventriculus (*pr.*). Two long lateral cœca (*a.c.*) arise from the anterior part of the midgut, just behind the proventriculus and, directed backwards, are tightly applied to the lateral sides of it. The midgut (*m.g.*) is in the form of a straight cylindrical tube. The four Malpighian tubes (*M.*) arise separately at the junction of the mid- and hind-gut. These four tubes lie in the posterior part of the body and surround the hind-gut.

The salivary glands (*s.g.*) are tubular and extend a small distance behind the posterior end of the anterior cœca.

The pupa (Pl. IV. fig. 24) is 8 mm. in length, completely free from the larval skin, and brown in colour. The head is much recurved on the ventral side, and the thorax, which projects forward, bears a pair of prothoracic respiratory horns (*p.h.*). The legs of the pupa are not superposed as is often the case in dipterous pupæ, but lie in the same plane. Each abdominal segment bears dorsally a row of short spines. The last segment (Pl. IV. fig. 25) is furnished with five pairs of hooks curved dorsally.

III. *Symmerus annulata*, Meigen.

All our knowledge of the larvæ of *Symmerus* was contained in a short sentence of Winnertz (1863, p. 671), who bred "one female from a larva which lived in a decomposed fungus on *Carpinus betulus*."

During the month of May of this year Mr. Edwards in-

formed me that he had found a specimen of *Symmerus annulata* which had hatched in one of his breeding-jars. "The larvæ of this species," he added in his letter, "were boring in a piece of rotten elm wood. They are almost transparent and glassy in appearance, and, like those of *Ditomyia*, move very little and very slowly. The pupæ wriggle in an almost snake-like manner when extracted from their habitat. Unfortunately I found that all the full-sized larvæ had pupated. I have one larva preserved in spirit."

All the material Mr. Edwards could send me consisted of an empty pupa with a moulted larval skin attached to it and the larva preserved in spirit, mentioned in his letter.

This was, however, quite sufficient for the complete morphological study of this larva.

The larva of *Symmerus annulata* (Pl. V. fig. 26) is 11 mm. in length; its last abdominal segment bears the posterior spiracles, but is without the dorsal paired prominences which are present in *Ditomyia* larvæ. These two larvæ are easily distinguished from one another by their colour and post-abdominal prominences, but they are quite similar in the detailed structure of almost all their organs.

The antennæ (Pl. V. fig. 32), labrum (fig. 27), mandibles (fig. 31), maxillæ (fig. 29, *m.x.*), and labium (fig. 29, *l.b.*), with their palps (*m.p.*, *l.p.*) have the same structure as those of *Ditomyia* larvæ. The differences in detail of these organs in these two larvæ are shown in the above-mentioned figures.

We may mention only that in the maxillary palps of *Symmerus* larvæ we do not find the lateral sensory papilla which is well developed in *Ditomyia* larvæ (Pl. IV. fig. 17, *l.s.*). The labium in *Symmerus* larvæ is more rounded.

The thoracic and abdominal segments also bear the sensory hairs, and the remains of the thoracic legs are represented by three sensory hairs (fig. 30).

The last abdominal segment is rounded.

The respiratory system is peripneustic, with nine pairs of functional spiracles: one prothoracic and eight abdominal.

The spiracles (figs. 33 & 34) are very small, and their structure is similar to those of the first seven pairs of abdominal spiracles of *Ditomyia*.

Pupæ (fig. 28). Unfortunately I have only one empty skin of a pupa. I may mention, however, that the prothoracic horns are more elongated than in the pupa of *Ditomyia*, and that the thoracic segments bear a row of lateral short hooks.

The study of the larvæ and pupæ of *Ditomyia* and *Symmerus* shows clearly the great similarity in structure of nearly all their organs. It also shows, on the other hand, that the larval and pupal structure of these two genera is totally different from that of all the Mycetophilidæ.

The difference is especially striking in the structure of the antennæ, mandibles, maxillæ, and labium, with their palps, the sensory organs, respiratory system, structure of the spiracles, the salivary glands, and, finally, the form of the pupæ.

These two genera must therefore be re-united in a special family, the Ditomyidæ, which itself must be completely separated from the family of the Mycetophilidæ.

From the study of the larval and pupal characters it follows that the family Ditomyidæ must occupy among the Diptera Orthorrhapha Eucephala, of Brauer, a position equally important with that of the Mycetophilidæ, Bibionidæ, Rhyphidæ, &c.

As to the relations of this new family to the others we can state only that the larvæ of Ditomyidæ bear a closer resemblance to the larvæ of Bibionidæ than to those of any other Diptera, and more especially when we compare their labra, mandibles, maxillæ, and the structure of the spiracles.

The subfamily Mycetobiinæ of Winnertz (1861), composed of the genera *Mycetobia*, *Mesochria*, *Ditomyia*, and *Symmerus*, must therefore completely disappear, as *Mycetobia* (and with it, according to Edwards, *Mesochria*) must be transferred to the Rhyphidæ; while the two others go to form a separate family, Ditomyidæ, completely separated from Mycetophilidæ.

I must express here my best thanks to Mr. F. W. Edwards for sending me the specimens of *Ditomyia* and *Symmerus* larvæ. I may say that it is his re-discovery of these larvæ which has enabled me to accomplish this study.

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EXPLANATION OF THE PLATES.

PLATE II.

- Fig. 1. Head of the larva of *Rhyphus fenestralis*, Scop., ventral aspect. *a.* and *b.*, sensory organs of maxillary palp; *c.m.*, comb-shaped plate of labrum; *l.p.*, labial palp; *l.r.*, labrum with its anterior ventral prominence; *m.d.*, mandibles; *m.p.*, maxillary palp; *m.x.*, maxilla; *p.r.*, posterior ventral prominence of labrum; *t.n.*, tentorial rods.
- Fig. 2. Head of the larva of *Mycetobia pallipes*, Mg. Letters as in fig. 1.

PLATE III.

- Fig. 3. Larva of *Mycetophila blanda*, Winn., viewed laterally.
- Fig. 4. Head of the larva of *Bolitophila fusca*, Meig.; dorsal aspect. *A.m.*, antennæ; *E.*, eyes.
- Fig. 5. Mandible of *Mycetophila blanda*, Winn.
- Fig. 6. Labrum of *Bolitophila fusca*, Meig.
- Fig. 7. Mandible of *Mycomyia marginata*, Meig.

42 *Larvæ &c. of Mycetobia, Ditomyia, and Symmerus.*

- Fig. 8.* Labrum of *Mycomyia marginata*, Meig.
Fig. 9. Pleural sensory organ representing the remains of thoracic legs of *Mycomyia marginata*, Meig.
Fig. 10. Maxilla of *Mycomyia marginata*. *m.x.*; *m.p.*, maxillary palps.
Fig. 11. Maxilla of *Bolitophila fusca*, Meig.
Fig. 12. Maxilla of *Mycetophila blanda*, Winn.
Fig. 13. Antenna of *Bolitophila fusca*, Meig.

PLATE IV.

[All the figures of this Plate concern the larva and pupa of *Ditomyia fasciata*.]

- Fig. 14.* Larva of *Ditomyia fasciata*, viewed laterally.
Fig. 15. Labrum, ventral side. *d.*, dental chitinous plate; *p.l.*, ventral plate.
Fig. 16. Alimentary canal of the larva. *a.c.*, anterior cœca; *m.g.*, mid-gut; *M.*, Malpighian tubes; *o.e.*, œsophagus; *p.r.*, proventriculus; *s.g.*, salivary glands.
Fig. 17. Maxillæ and labium of larva. *l.b.*, labium; *l.p.*, labial palps; *l.s.*, lateral sensory organ of the maxillary palp; *m.p.*, maxillary palp; *m.x.*, maxillæ; *t.b.*, transversal chitinous band of the cardo of maxilla; *s.h.*, sensory hair of the internal lobe of maxillæ.
Fig. 18. Abdominal spiracle of larva.
Fig. 19. Sensory organ—remains of thoracic leg.
Fig. 20. Last pair of abdominal spiracles. *f.c.*, felt-chamber ("chambre feutrée"); *T.r.*, tracheal trunks; *s.c.*, external scar; *s.p.*, spiracles.
Fig. 21. Prothoracic spiracle—the black surface represents the external scar of this spiracle.
Fig. 22. Mandibula.
Fig. 23. Antenna. *b.s.*, bell-shaped sensory organ; *p.*, biarticulated papilla.
Fig. 24. Pupa, viewed laterally. *p.h.*, prothoracic respiratory horns.
Fig. 25. Posterior end of this pupa, showing the hooks.

PLATE V.

[Figs. 26-34 concern larva and pupa of *Symmerus annulata*.]

- Fig. 26.* Larva of *Symmerus annulata*, viewed laterally.
Fig. 27. Labrum of the larva. Letters as in fig. 15.
Fig. 28. Pupa of *Symmerus annulata*.
Fig. 29. Maxilla and labium of this larva. Letters as in fig. 17.
Fig. 30. Sensory organ—remains of thoracic leg.
Fig. 31. Mandible.
Fig. 32. Antennæ. Letters as in fig. 23.
Fig. 33. Abdominal spiracle.
Fig. 34. Last abdominal spiracle.
Fig. 35. Mandible of the larva of *Rhyphus fenestralis*.
Fig. 36. Mandible of the larva of *Mycetobia pallipes*.
Fig. 37. Antenna of *Mycetobia pallipes*.
Fig. 38. Larva of *Mycetobia pallipes*, viewed dorsally.

V.—Description of a new Genus and Species of the
Homopterous Family Cicadidæ. By W. L. DISTANT.

IN the Ann. & Mag. Nat. Hist. (ser. 9, vol. i. p. 196) I brought the number of recorded species of Cicadidæ from Indo-China to the total of 75. Mons. R. Vitalis de Salvaza, in his last consignment to the British Museum, has included the beautiful genus and species here described, and the number of known species from this rich district must now be recognized as 76.

AYUTHIA, gen. nov.

Head including eyes narrower than base of mesonotum, almost the length of pronotum; front obliquely depressed; ocelli considerably farther removed from eyes than from each other, and their interspace strongly, broadly, longitudinally foveate; pronotum distinctly shorter than mesonotum, laterally moderately convexly amplified where the extreme margin is coarsely serrated, the posterior marginal area moderately broad and at the lateral angles angularly truncate; abdomen in male longer than space between apex of head and base of cruciform elevation, the dorsal surface moderately oblique on each side; tympanal orifices concealed; metasternum elevated; opercula in male short and broad, extending beyond base of metasternum; anterior femora strongly spined beneath; rostrum reaching base of metasternum; tegmina and wings semiopaque, tegmina with eight apical areas.

Allied to *Tosena*, A. & S.

Ayuthia spectabile, sp. n.

♂. Head and pronotum black, moderately palely pilose; head with the eyes, ocelli, and intra-ocular suffusions, narrow anterior and broader posterior margins of pronotum castaneous, the latter with three prominent black spots; mesonotum castaneous, with two large central obconical spots at anterior margin, followed by a longer, but more imperfect spot on each lateral area, a central fasciate line, the anterior angles of the cruciform elevation and two spots in front of same, pale castaneous; body above black; body beneath castaneous with black suffusions; face castaneous, with the apical area black; tegmina with nearly basal half opaque creamy-white,

the venation pale castaneous, apex of basal cell, a curved linear fascia extending from base of upper ulnar area to base of lower apical area, and a spot at the apices of the ulnar areas and apical veins black; wings (excluding extreme apical area) opaque creamy-white, the veins narrowly pale castaneous; rostrum reaching base of metasternum; other structural characters as in generic diagnosis.

Length, excl. tegm., ♂ 40, ♀ 35; exp. tegm. 120 mm.

Hab. Indo-China (*R. Vitalis de Salvaza*).

A more precise habitat is yet to be received.

VI.—Notes on the Asilidæ: Sub-division Asilinæ.

By GERTRUDE RICARDO.

THE Asilidæ of Australia having been to a certain extent revised and described in the *Ann. & Mag. Nat. Hist.* [ser. 8, ix. (April, May), x. (July, Sept.) 1912; xi., January, April, May 1913; ser. 9, i., January 1918], this paper is the beginning of an attempt to bring the Asilidæ of the Oriental and South African Regions into some order, and to name such new species as are to be found in the Brit. Mus. Coll. and others sent me by Mr. L. Peringuey from the Cape Museum. The genera *Machimus*, *Neoitamus*, and *Heligmoneura* are here dealt with. The types are all in the Brit. Mus. Coll., unless otherwise specified.

MACHIMUS, Loew.

Linn. Ent. iv. 1, 3 (1849).

This genus has as yet only been represented in the Oriental Region by *Machimus coruscus*, V. d. Wulp, from Java, a species unknown to me, and by *Machimus atratulus*, Wlk., mentioned below.

The species described from the South African Region are *Machimus lepturus*, Gerst., from Zanzibar, and *Machimus caudiculatus* and *penicillatus*, Speiser, both from East Africa.

Ten new species are now described from India and Ceylon, and one from S. China. The South African Region is represented by one new species.

Asilus atratulus, Walker, from Java, is placed by Wulp in this genus, the type (a female) is in the Brit. Mus. Coll., but in such a bad condition it is impossible to decide even its generic rank. It is a small blackish-brown specimen.

Moustache black. Legs piceous. Wulp thought he identified this species among specimens from Java and says the genitalia are black.

Asilus deformis, Walker, from Arabia, the type, a female, is in the Brit. Mus. Coll., but, as in the above it is impossible to decide what genus it belongs to, it may possibly be included in the genus *Machinus*, and is certainly not in *Apoclea*, where it is placed in Kertész's Catalogue.

Machinus chinensis, ♂ ♀, sp. n.

Type (male), June 1899, and type (female), 1906, 89, from T'inghai, China (*P. de la Garde*), and another male and female from the same locality.

A large blackish species, covered with yellowish-grey tomentum; tibiæ and tarsi reddish. Moustache yellow, a few black hairs above.

Length, ♂ 23, ♀ 28 mm.

Male.—*Face* covered with yellow tomentum; tubercle large, darker; moustache composed of yellow bristles and a few black ones above and down the sides. Palpi black with yellow hairs. *Antennæ* blackish, the first two joints with black hairs, some being very stout bristles, the third joint is as long as the first two joints together; the arista not quite so long as the joint. *Forehead* with black bristly hairs. *Thorax* covered with greyish-yellow tomentum and the usual dark stripes, the median one not divided, a dark rich brown in colour, the side ones olive-coloured. Præsutural bristles three, supra-alar bristles three, postalar bristles two, one is yellow; dorso-central bristles about ten in number; pubescence on dorsum short, black, with some longer hairs intermixed. *Scutellum* with four black bristles on its margin. *Abdomen* covered with yellowish-grey tomentum, with dark brown large spots on each segment, the segmentations paler; sides with yellow bristles, continued on to the dorsum; on the segmentations pubescence consists of short, thick, appressed, fulvous hairs. Genitalia black, with chiefly black pubescence; the eighth ventral segment is produced to a short point, clothed with chiefly yellow bristly hairs. *Legs* black; tibiæ and tarsi bright reddish yellow, a little darker at the apices; fore femora with six bristles below, one near apex and two at apex, the middle ones with five below and two near apex, the hind ones with four below and two long white ones at the extreme base, two black ones on the upper-side, two near apex, and two at apex; the pubescence on femora is short, yellowish, on tibiæ and tarsi black. *Wings*

large, clear, with a yellowish tinge; veins yellow, the small transverse vein beyond the middle of the discal cell.

Female identical, the bristles on thorax and scutellum almost entirely yellow; the short bristles on the hind femora below are seven, with three on the upperside; ovipositor short, black.

The femora in the other male and female are reddish yellow.

Machinus assamensis, ♂ ♀, sp. n.

Type (male) and type (female) from Assam (W. F. Badgley), 1906, 185.

A handsome black species with yellow pubescence, in general appearance somewhat similar to *Machinus dubius*, sp. n. Legs with few bristles, uniformly black, with some yellow pubescence. Moustache black and yellow.

Length 22 mm.

Male.—*Face* covered with yellowish tomentum; tubercle large. Moustache composed of black bristles above and bright yellow bristly hairs below. *Palpi* black, with black hairs. Beard bright yellow, thick hairs round head the same colour, mixing with the postocular black bristles. *Antennæ* blackish brown, the first two joints with black bristly hairs, third joint broken off. *Thorax* greyish yellow, almost entirely covered by the blackish-brown stripes; præ-sutural bristles three in number, supra-alar three, post-alar two, all black and very long and strong; the dorso-central bristles apparently ten or so in number, interspersed with long black hairs; pubescence on dorsum black. *Scutellum* with four black bristles on its margin. *Abdomen* greyish yellow, the usual blackish spot on each segment gives the abdomen a black appearance; pubescence at sides and on dorsum bright yellow; genitalia shining black, with black and yellow hairs; the eighth ventral segment produced to a long blunt point covered with black hairs and with yellow hairs at the sides. *Legs* black; femora stout with short white pubescence and longer white hairs below, no bristles on the first pair, only two or so on the middle pair, very long and strong, on the hind pair two below, four on the upperside and two at apex, fore and middle tibiae with yellow short hairs, the hind pair with black hairs, all with black bristles, the fore and hind pair and metatarsi with a thick fringe of appressed fulvous hairs on under surface. *Wings* grey, only a streak of pale colour in the middle and

at the base, small transverse vein beyond the middle of discal cell.

Female identical, but the abdomen has some black pubescence on the dorsum.

Machimus cœrulescens, ♂, sp. n.

Type (male) (201) from Bhim Tal, 18. 6. 1912; and another male from Binsar, 23. 5. 12 (Imms Coll.), Kumaon.

A species distinguished from the other species of *Machimus* from India by the blue-black colour of the abdomen. *Wings* deep brown, clear at extreme base. *Legs* black. Moustache yellow with a few black bristles.

Length $18\frac{1}{2}$ mm.

Face covered with yellow tomentum; tubercle large, blackish, covered by a dense yellow moustache; the black bristles are above and at the sides. Beard yellow. *Palpi* black with black hairs. *Thorax* blackish brown with an indistinct median grey line; shoulders and sides covered with greyish-yellow tomentum; præsutural, supra-alar, and postalar bristles severally two in number, black; the dorso-central ones are apparently two on each side with black hairs, mostly short, but some long ones intermixed on the dorsum. *Scutellum* blackish with ashy-grey tomentum, which is also present on the posterior part of thorax; bristles on scutellum appear to be four in number, now broken off. *Abdomen* uniformly blue-black, with white segmentations on the second, third, and fourth segments, appearing again on the apical segments; pubescence black; genitalia black with black hairs, the eighth segment below produced to a blunt short point with long black hairs. *Legs* greenish black; the fore femora with black hairs, two or three being long and bristle-like; middle femora stout with a row of short bristles below and two longer, very stout ones on the sides; hind femora with four or more stout long ones below and black hairs; tibiæ with numerous stout black bristles and soft black hairs below; tarsi with the same, especially the first joints; some reddish-yellow, very short pubescence is visible on the undersides of the tibiæ. *Wings* with only the basal cells and part of the anal cell clear; small transverse vein oblique, beyond the middle of the discal cell.

Machimus dubius, ♂ ♀, sp. n.

Type (male) (177) from Dharmoti, 7. 6. 1912.

Type (female) (17) from Bhowali, 5700 feet, July 1909 A. D. Imms), and others from Takula, all in Kumaon.

A large blackish species, not unlike *Machinus armipes*, Becker, judging from the description, found in the province of Beluchistan, Persia; but the bristles on fore femora are more than two in number and those on the scutellum only four or five, not ten as in Becker's species. In this species the typical characteristic of the genus, viz., the production of the eighth ventral segment, is not very conspicuous, which is apparently also the case in Becker's species.

Length, ♂ 20-23, ♀ 20-26 mm.

Male.—*Face* and tubercle covered with pale yellowish tomentum; moustache composed of stout, long, yellowish-white bristles, with two black bristles below at each side. *Palpi* black, with long black hairs. Beard whitish yellow, the hairs round the head similar, but becoming bristles halfway up. *Antennæ* blackish brown, the first two joints with black hairs, the third with a style about the length of the joint. Postocular bristles black and very stout. *Thorax* greyish yellow with the usual brown stripes, the median one hardly divided anteriorly; the dorsum of thorax covered with small, very short, black bristles, the large bristles all black; the præsutural, supra-alar, and postalar all two in number; the dorso-central bristles are about ten, disposed in two rows, a few long black hairs are intermixed with them. *Scutellum* with four or five very stout, long, black bristles and with fine yellow hairs. *Abdomen* with the usual large black-brown spot on each segment, leaving the segmentations yellowish grey; the first segment has a tuft of yellowish hairs at each side and two long black bristles below; the next four segments with yellowish short bristles at the sides, continued on to the dorsum as fine yellowish bristly hairs; the eighth ventral segment only slightly produced with some long black bristly hairs on its margin and a few white ones beyond. *Legs* black, with appressed whitish pubescence; femora all stout, the fore pair with three black bristles above and four below, the middle pair with about nine in two rows and four at the apex; the hind pair with six below and one or two long white bristles at the base, four above and two near the apex and three at the apex; the fore femora with long, fine, yellowish hairs below; the fore tarsi with black ones and with orange-red appressed pubescence underneath, which is also present, but paler in colour on the hind pair; both the middle and hind pair have black hairs below, not so long as those on the fore pair; all tibiæ and tarsi armed with stout black bristles. *Wings* clear, the shading on fore border and apex not very distinct; the

small transverse vein oblique, at about the middle of the discal cell.

Female is identical, the long pubescence on the legs not so marked; ovipositor black, not much longer than the preceding segment.

Machinus hirtipes, ♂, sp. n.

Type (male) from Khasi Hills, Assam (*A. Chevelf*), 96, 135, and two damaged specimens (? ♂ or ♀) from the same locality.

A medium-sized greyish-yellow species, distinguished by the pubescence on the abdomen and by the long hairs on the legs, the femora being red with a black stripe on their inner sides, the tibiae the same.

Length 20 mm.

Face with greyish-yellow tomentum; the tubercle darker, large; the moustache composed of numerous stout black bristles, with some yellow ones below. *Pulpi* black with black hairs. *Antennae* blackish brown, the first two joints with black hairs. Beard yellow. Hairs round head the same colour; occipital bristles black. *Forehead* with black hairs. *Thorax* covered with bright greyish-yellow tomentum, the median stripe dark blackish brown, the side-stripes paler in colour; pubescence on dorsum black, consisting of short hairs and longer ones intermixed with the long, stout, black bristles; præsutural bristles two, supra-alar two, postalar three, dorso-central about twelve. *Scutellum* the same colour, with six long black bristles on its margin and some short black hairs on its dorsum. *Abdomen* greyish yellow with a dark spot on each segment and the segmentations paler; yellow bristles on sides, and soft yellow hairs and shorter yellow hair on the dorsum; genitalia reddish, black at apex with chiefly black hairs; eighth ventral segment produced to a rounded broad point ending in black hairs; the whole segment is hairy, all the under surface of abdomen with yellowish hairs. *Legs* reddish with black stripes on femora and tibiae; fore femora clothed with long yellowish hairs above and below; middle femora with fewer, and with two long bristles below and two at apex; the hind pair has bristles below and on the sides, and some long yellowish and black hairs; tibiae with yellow hairs; tarsi with black pubescence; all bristles on the legs are black. *Wings* clear with grey shading on apex.

Machimus indianus, ♂ ♀, sp. n.

Type (male) from near Bhowali (Kumaon), 5700 feet, July 1909.

Type (female) from Sham Ket, near Bhowali, 15.5.1912.

Other specimens from Dharmoti, 5300 feet; Bhim Tal; Takula; Airades; Chaubattia; Sat Tal; all localities in Kumaon. May and June 1912.

One male from Thundiani, W. Himalayas, 9000 feet, 4.7.1907 (*Major H. A. Morgarth*), 1907, 273.

Two females and one male from Mussooree, U.P. (*T. E. Middleton*), 1911, 418.

A rather large black species with white bands on the abdomen. Moustache white. Fore femora with usually three bristles below. *Wings* shaded at apex, on fore border, and on posterior border, leaving only the centre of wing clear.

Length, ♂ 19-23, ♀ 19-22 mm.

Male.—*Face* covered with yellowish-grey tomentum; the tubercle large, blackish, covered by the long, strong, yellow bristles which form the moustache, with two black bristles below on each side. *Palpi* black, with black hairs. Beard white and thick; the hairs round head white, becoming bristles posteriorly. *Antennæ* blackish, the first two joints with black hairs, the third with a style two-thirds of its own length. *Forehead* with yellow short hairs on each side. Postocular bristles stout and black, curved forwards. Collar with chiefly yellow bristles. *Thorax* yellowish brown, the median stripe dark brown, with a very narrow pale line dividing it anteriorly. Præsutural bristles three, supra-alar two, postalar two, sometimes three, all very strong black ones; dorso-central bristles about ten. Dorsum covered with very small, black, appressed bristles, a few long black hairs between the dorso-central bristles. *Scutellum* same colour as thorax, with yellowish pubescence and four very strong marginal bristles turned upwards. *Abdomen* yellowish grey, with dark blackish-brown square spots on each segment, so that the abdomen viewed generally appears blackish, with the segmentations whitish yellow; the first segment is armed with numerous black bristles of different sizes, on the sides with yellowish ones, which are also present on the sides of most of the segments, advancing towards the centre of dorsum on the anterior segments; short yellowish hairs are intermingled with these and continued above the hind margins of segments; underside with long weak white hairs; genital organs large, black, with short yellowish pubescence; the eighth

segment is produced ventrally to a short point armed with long black hairs, six or more in number. *Legs* uniformly blackish; the coxæ with long bristle-like yellow hairs; the femora stout with short white pubescence; the fore femora armed with usually three bristles below, very occasionally four are present, and with three above; the middle femora with about nine in three rows, two more near the apices, and two at the apex; the hind femora with sixteen or so bristles in three rows, two more near the apices, and four at the apices; tibiæ with strong bristles above and below, the tarsi also with very many strong bristles; tibiæ and tarsi with the same pubescence as the femora, all bristles black; femora and tibiæ have also long white hairs below, thickest on the front ones; the fore tibiæ and the hind tibiæ have deep orange-red pubescence on their lower outer edges; the first joints of tarsi on fore and hind legs have the same-coloured pubescence on their under surface.

Female identical. The fore femora with often only two bristles at the apex, the three above are very often absent, and the hind femora often have only three at the apices. The ovipositor is black with black hairs, not much longer than the last segment.

Machinus khasiensis, ♂ ♀, sp. n.

Type (male) and type (female) from Lower Ranges, N. Khasi Hills, Assam, 1878 (*A. Chennell*), 96, 135.

A species very similar to *Machinus hirtipes*, sp. n., but distinguished by the wholly black legs.

Length 17 mm.

Male.—Stripes of *thorax* are probably not so distinct, the median stripe not so dark; præsutural bristles three, supra-alar three, postalar two. *Abdomen* greyish yellow, the dark spot on each segment not very distinct; pubescence as in *M. hirtipes*; genitalia wholly black, the eighth ventral segment the same, but the hairs on the long projection are only black above, yellow and long below. *Legs* blackish; the fore femora with only three bristles above and long yellow hairs below, the mid-femora with three and two at apex, the hind femora with three above and three below in the female, but apparently fewer in the male, a few pale bristles are present; pubescence on femora short and yellowish, the same on the tibiæ, which have also thick appressed fringes of rufous hairs on their under surfaces. The species is distinguished from *Machinus nigrinus*, sp. n., by the paler colouring of the abdomen and its thicker

pubescence and by the longer, more pointed eighth ventral segment.

Machimus montanus, ♂ ♀, sp. n.

Type (male), type (female), and others from Kotagiri, Nilghiri Hills, 6000 feet (*F. M. Cragg*).

A small greyish species, very similar in appearance to the European *M. atricapillus*, but at once distinguished from it by the eighth ventral segment, which is not two-horned. *Legs* black with reddish stripes, all the bristles black.

Length, ♂ 13-14, ♀ 15 mm.

Male.—*Face* covered with greyish tomentum; the tubercle blackish, large, covered with the black moustache, which is composed of very strong black bristles with weaker white ones below. *Palpi* black, with black bristly hairs. *Beard* and hairs round head white. The postocular bristles stout, black, curved forwards. *Forehead* blackish in the centre, greyish yellow at the sides with a few black hairs and two or three white hairs. *Antennæ* blackish brown, with black bristly hairs on the first two joints. *Thorax* yellowish grey with the median blackish-brown stripe very distinct, becoming a little narrower posteriorly; sides with paler-coloured, broad, interrupted stripes, not extending far beyond the suture; dorsum of thorax with small black bristles; two very strong præsutural bristles, two supra-alar, and three postalar, all very strong; the dorso-central ones number about twelve, with weaker ones intermixed, only two being præsutural. *Scutellum* yellowish grey, with some weak yellow and black bristles and with four large black marginal bristles curved forwards. *Abdomen* brownish grey or blackish grey, the segmentations lighter; the dorsum covered with very small, depressed, black bristles, and with longer yellow hairs at the sides. *Genitalia* reddish, the claspers blackish at apices; pubescence yellowish; the eighth ventral segment produced, ending in a point with long black hairs which extend to the sides, on its inside it is reddish yellow in colour.

Legs blackish; the femora reddish on their outer sides; tibiæ only black on their undersides; tarsi reddish, apices black; femora and coxæ with long white hairs, thickest on the fore pair, the middle pair with four strong bristles in the middle and two at their apices, the hind pair with three near the apices and two or more nearer the base and others beneath; the tibiæ with numerous long black bristles and with some weak yellowish hairs, which are long on the front

pair on the under surface; tarsi with similar long black bristles. *Wings* hyaline, grey on fore border and at apex, with grey streaks in the posterior cells, the small transverse vein barely beyond the middle of the discal cell.

Female identical, but the moustache is entirely black; ovipositor black, compressed, about the length of the two preceding segments together; abdomen with the pale segmentations more distinct and wider.

Machimus nigrinus, ♂ ♀, sp. n.

Type (male) (160), type (female) (148), and a series of both males and females from Bowdali, 5700 feet, July 1909; Khati, 7650 feet, 30. 5. 09; Bhim Tal, 18. 6. 12; Binsar, 28. 5. 12; Takula, 27. 5. 12; Airades, 1. 6. 12; Chaubattia, 13. 6. 12; all localities in Kumaon.

A small blackish species, distinguished from *Machimus montanus* by the wholly black legs and from *Machimus indianus* by the absence of bristles on the underpart of the fore femora. Abdomen blackish with greyish segmentations. Moustache black and white.

Length, ♂ 14-17, ♀ 13-17 mm.

Male.—*Face* covered with yellowish-white tomentum; tubercle large, blackish, covered with black stout bristles and long white bristles intermixed on the lower part, all forming the moustache. *Palpi* black with black hairs. Beard and hairs round head white. *Antennæ* blackish, the first two joints with black hairs, the third with a style about two-thirds of its length. *Forehead* blackish with black hairs, postocular bristles black. *Thorax* yellowish brown, the median stripe blackish brown, with a very fine dividing-line anteriorly, the side-stripes the same colour; præsutural bristles two in number, two supra-alar bristles, two postalar bristles, and about six dorso-central stout bristles, many fine bristles or hairs intermixed with them. *Scutellum* with six marginal bristles. *Dorsum* of thorax covered with short black bristles. *Abdomen* greyish, with a large brownish-black spot on each segment, not attaining the posterior border; sides of segments with weak yellowish bristles. *Genitalia* large, black, with chiefly black pubescence; the eighth ventral segment produced considerably, but not to a point, fringed with black hairs, at the sides they become sparse and yellow. *Legs* black, covered with greyish short pubescence; the fore femora with long black hairs below, no bristles; two very strong bristles near apex, middle femora with two very stout bristles at the apices, two or more on

upper border at sides, below only black bristly hairs are present; posterior femora with four black bristles below, two at the apex, and four on the upper border, all bristles on the legs are black; the fore tibiæ with a regular row of black bristles all the same size above and some soft hairs intermixed, other stronger bristles below; fore tibiæ and tarsi, also the posterior tibiæ and tarsi, clothed below with short rufous pubescence. *Wings* clear, shaded brown on the fore border, at apex, and in the centre of the cells on the posterior border.

**Female* is similar. Ovipositor black, barely the length of the last two segments.

Machimus parvus, ♂ ♀, sp. n.

Type (male) and four other males.

Type (female) and three other females, all from Kotagiri, 6000 feet, Nilgherri Hills (*F. M. Cragg*). Males and females from Trincomalee, Dambula, Ceylon (*Yerbury*); and from Horaweputone, Mahaganay, and Kenaratyodes, Ceylon; one female from Biserat, Siam (*H. C. Robinson and N. Annandale*), 1910, 21.

A small species distinguished by the bright red genitalia of the male, and in both sexes by the bristles on the abdomen being almost entirely black, and by the absence of any real bristles on the fore femora. Abdomen black with yellowish segmentations. Legs black.

Length, ♂ 9-10, ♀ 10-11 mm.

Male.—*Face* with yellowish tomentum; tubercle very large, covered with stout black bristles and a few white weak bristles appearing below, all comprising the moustache. *Palpi* black with black hairs. Beard yellowish. *Forehead* with black hairs. *Antennæ* blackish brown, the style of third joint barely more than half the length of joint. Postocular bristle black. *Thorax* greyish with blackish-brown stripes, the median divided by a fine line anteriorly. Præsutural bristles two in number, supra-alar two, postalar two; dorso-central bristles about twelve, in two rows extending beyond the suture; dorsum of thorax with short black hairs. *Scutellum* with four very long bristles. *Abdomen* greyish, the first segment blackish, the second and third segments each with a large black spot having only the anterior and posterior borders grey, the fourth and fifth with similar spots, but only the posterior borders greyish, the remaining segments chiefly grey; all the bristles and hairs on sides black; genitalia large, bright red, shining, with some black

hairs; the eighth ventral segment produced, with a fringe of black hairs. *Legs* black; all the femora with long black hairs below, sometimes rather bristle-like; the middle femora with three bristles at the apex and one near the apex, the posterior pair with four on the upperside, two at the apex, and two near the apex; tibiae and tarsi with strong black bristles; the tibiae on their outer edges with a fringe of fine, short, whitish hairs, continued on the first two joints of tarsi, this fringe is most noticeable on the hind pair of legs. *Wings* clear, the usual shading very faint, the small transverse vein just before the middle of the discal cell or sometimes beyond it.

Female is similar. Ovipositor black, about the length of the last two segments.

Muchimus tibialis, ♂ ♀, sp. n.

Type (male) (216) from Dehra Dun, U.P., 3. 4. 1912.

Type (female) (218) from Dehra Dun, U.P., 1. 4. 1912; and others from same locality and Bhawal, Kumaon, 5700 feet, July 1909, all from Innis Coll.

A small species with reddish-yellow tibiae and some of the femora with a reddish-yellow stripe on the inside. Abdomen greyish yellow, with paler segmentations. Moustache black and white.

Length, ♂ $13\frac{1}{2}$, ♀ 15–17 mm.

Male.—*Face* with grey tomentum; tubercle fairly prominent. Moustache composed of bristly white hairs, with black ones above and at sides. *Palpi* black with black hairs. Beard white. *Antennæ* blackish brown, the second one reddish, both with black bristly hairs below and whitish short hairs above, the third with an arista two-thirds of its length. *Forehead* with black hairs. Hairs round head whitish, the postocular bristles black. *Thorax* greyish yellow with the usual stripes; the præsutural bristles, the supra-alar, and postalar all two in number, black; the dorso-central bristles about eight in number, all accompanied by some long, fine, black hairs. *Scutellum* paler with pale yellowish pubescence and with six long bristles on its margin, some of these being yellowish. *Abdomen* greyish yellow, with a large dark spot on each segment; the segmentations lighter, the first three segments with whitish weak bristles on their sides; a few white hairs are visible on the sides of the others and on the segmentations of the last two segments; pubescence on dorsum very short, black; genitalia blackish above and reddish below, with chiefly

black pubescence; the eighth ventral segment small and very slightly produced, fringed with fairly long pale hairs. *Legs* yellowish; the femora blackish on their outer sides, all covered with short white pubescence; the fore femora with only soft yellowish hairs above and below, the middle pair with at least four black bristles and two at the apex, soft yellow hairs below, the posterior pair with four bristles below, one above, two near apex and two at the apex, and soft yellow hairs below; tibiæ with chiefly black pubescence on the first pair and a fringe of appressed reddish hairs on under surface; on the other tibiæ it is chiefly whitish, all with numerous black bristles. *Wings* clear, shading at apex and on posterior border faint, the small transverse vein is just beyond the middle of the discal cell.

Female is identical, the bristles on the scutellum only four in number; ovipositor short, blackish; femora more largely black on their outer sides, and the tibiæ have also a black streak; the tarsi blackish at their apices; some of the bristles on legs are yellowish. The male is very probably immature, so that others may be found with the femora as in the female.

Machimus ugandiensis, ♂ ♀, sp. n.

Type (male) and another from Mpunga Forest, Toro, 4800 feet; Uganda, 13-23 Nov., 1911 (*S. A. Neave*), 1912, 193; other males from Uganda Protectorate S. of Lake George, 3200-3400 feet, 17-19 Oct., 1911; from Dara or Durro Forest, Toro, 4000-4500 feet, 25-29 Oct., 1911; and from Buamba Forest, Semliki Valley, 2300-2800 feet: all by the same collector.

Type (female) from Mpunga Forest, others from Mabira Forest, Chagwe, 3500-3800 feet; from Buamba Forest, from between Seziwa River and Kampala, 3500-3750 feet; from Western Ankola, 4500-5000 feet, 10-14 Oct., 1911; and from Brit. E. Africa, edge of forest on S. and E. slopes of Kenya, 6000-7000 feet: all by the same collector.

This species is apparently nearly allied to *Machimus caudiculatus*, Speiser, from German E. Africa, but the description of the latter (not a very full one) describes the legs as yellowish grey on the fore tibiæ and tarsi and on the whole hind legs, being covered with close-lying yellow pubescence—in this species the legs are black and not clothed with these lighter hairs.

Length, ♂ $14\frac{1}{2}$ -16, ♀ 15 - $17\frac{1}{2}$ mm.

Male.—Face with golden-yellow tomentum. Moustache

on large tubercle composed of stout black bristles and a few weaker yellow ones below. *Palpi* black with black pubescence. Beard pale yellow. Proboscis clothed with pale yellow on its under surface. *Antennæ* black; the first two joints with black hairs and bristles, the third bare, the second is two-thirds the length of the first; the third is almost as long as the first two joints together, with a terminal bristle nearly as long as itself. *Forehead* same colour as face, with black hairs. *Thorax* with a median and side stripes deep black in colour, the rest of the dorsum is clothed with golden-yellowish tomentum and with short black hairs. *Præsutural* bristles three, supra-alar two, postalar two; the dorso-central bristles numerous, reaching the suture, all are stout and black, interspersed with smaller, finer, bristle-like hairs. *Scutellum* the same golden yellow as thorax or rather paler with short black pubescence and with four very stout black bristles on its posterior border. *Abdomen* blackish, showing traces of yellowish, or grey, or brown tomentum, with bright yellow hairs on the posterior borders of segments, which become longer and more like bristles at the sides; the dorsum elsewhere with fine black pubescence; underside greyish yellow, with yellow pubescence. *Genitalia* large and prominent, black with black hairs; the last segment on the underside with a finger-like stout process clothed with black hairs, which are thick at the tip, it is almost twice the length of the usual width of the segment. *Legs* deep black, with black bristles; the coxæ and the fore femora below with bright, soft, yellow, long hairs; the other femora with only short yellow pubescence on their upper and lower borders and with short black bristles and longer ones below which are sometimes yellow on the hind pair; the fore tibiæ also with long yellow hairs not so numerous, and with black and some yellow bristles, the black bristles on the outer side are very long, two or more in number; the middle tibiæ have not these, but yellow and black bristles of ordinary size and with some short yellow pubescence on their outer borders, the hind pair with black pubescence and bristles, and reddish or yellowish fringes of short hairs below on each apical border; the tarsi with black hairs and bristles, the first joint of hind pair with reddish or yellowish fringes in some of the specimens. *Wings* clear, grey at apex and on posterior border, leaving only the base and centre of wing clear; the small transverse vein this side of the middle of discal cell.

Female.—The yellow hairs on moustache are much less numerous, the yellow beard in both sexes is very thick and

continued round head; ovipositor short, not including the sixth or seventh segments. Fore femora with not so many yellow hairs below and with some darker ones intermingled, more bristle-like in two of the specimens; the bristles on scutellum are more numerous.

NEOITAMUS, Ost.-Sack.

Cat. Dipt. N. Amer. ed. 2, 82 & 235, 134 (1878).

Itamus, Loew, Linn. Ent. iv. 847 (1849).

This genus is represented in the Oriental Region by the following species: *Neoitamus griseus*, Wied; *Neoitamus longistylus*, *philus*, Wlk.—the former of these two includes six synonyms, see below.

Neoitamus javanensis, De Meijere; *Neoitamus spinicauda* and *melanopygus*, V. d. Wulp. Of these only *N. griseus* and *N. philus* are recorded from India and Ceylon. Nine new species are here described from India and surrounding districts, one from the Philippines, and one from Tientsin, S. China. From the South African Region only *Neoitamus armatus*, Becker, *podagricus*, Bezzi, and *N. sodalis*, V. d. Wulp from Arabia have been described. Two new species are now described.

All the species are fairly typical of the genus, with the exception of *N. pulcher* from Ceylon and *N. philus*, Walker.

Neoitamus griseus, Wied.

Dipt. Exot. p. 192 [*Asilus*] (1821); Wulp, Tijds. v. Ent. (2) vii. (xv.) p. 246 [*Itamus*] (1872). For other references see Kertész's Cat.

This species has been redescribed by Wulp, but unfortunately he does not specify very accurately the bristles on thorax and legs, and I have not been able to identify it with certainty, though a series from Ceylon in the Brit. Mus. Coll. may be this species, which is said to be about 20 mm. long, the femora having a black stripe on their upper border, otherwise they are reddish yellow.

Neoitamus philus, ♀, Walker.

List. Dipt. ii. p. 393 [*Asilus*] (1849), et vii. Suppl. 3, p. 725 [*Asilus*] (1855); V. d. Wulp, Tijds. v. Ent. xli. p. 145 [*Itamus*] (1898), et xlii. p. 55 [*Itamus*] (1899).

Type (female) from Silhet, 45, 107.

Females from Khasi Hills, Assam (*F. W. L. Staden*), purchased from Doncaster, 98, 202; from Khasi Hills, purchased from E. Heyne, 97, 82; and collected by A. Chennell,

93, 135; from Sikhim, June 1895, 2000 feet (*J. G. Pitcher*), 97, 120; Taungu, 11, 89 (*Bingham Coll.*); Haungtharaw River, Tenasserim, Burmah, Feb. 1890 (*Col. C. F. Bingham*), 96, 282.

An easily recognized species, not at all typical of the genus, however; *thorax* and *scutellum* covered with bright reddish-yellow tomentum; the short black *abdomen* has some same-coloured tufts of hairs on the first segment, elsewhere the pubescence is black; the ovipositor including the sixth and seventh segments is nearly as long as the rest of the abdomen. *Legs* reddish yellow; the base of femora and knees black. *Wings* large with yellow veins, shaded grey at apex and narrowly so on the posterior border.

Length 27 mm.

Neotamias longistylus, Wied.

Auszweiff. Ins. i. p. 453 [*Asilus*] (1823). For other references see Kertész's Cat.

Tamias latro, Dol.

? *Asilus terebatus*, Macq.

Tamias involutus, Wlk.

Tamias normalis, Wlk.

Tamias dipygus, Schiner.

Tamias dentipes, Wulp.

Asilus vertebatus, Wulp.

Wiedeman's species was described from New Guinea and the Indian Archipelago; to the synonyms given by Kertész I have added Walker's species *involutus* described originally from Ternate, *normalis* from the same place, and *dipygus*, Schiner, which was only distinguished by him from *involutus* by the colour of the tarsi, which were black in his species, not red as in Walker's species, and the dark colour of the wings was more diffused.

These are all apparently identical with Wiedemann's species—or, at the utmost, local varieties.

There are specimens of the species in the Brit. Mus. Coll. from Ternate, New Guinea (see Austen, Trans. Zool. Soc. London, xx. (13) p. 405, 1915), Gilo'o, and Batjan; also from Nantauri, Central Group, Nicobar Islands; Dinding, Siam; and Biserat, Siam—so that it appears to be a widely diffused species.

A handsome large species with tufts of golden hairs on the black *abdomen*. Male genitalia large and complicated, black with black hairs. Female ovipositor very long, almost as long as the other segments together; it includes the sixth and seventh segments. *Legs* are yellowish;

the femora at base and the knees black. Fore femora devoid of bristles, but with long soft black and white hairs below, the middle and posterior femora with a few black bristles and with short reddish-yellow pubescence; the tibiæ also have to a lesser extent long fine hairs below and some black bristles. Beard yellowish.

Length, ♂ 20-23, ♀ 25-27 mm.

For a more detailed description, see Schiner.

Neoitamus ceylonicus, ♂ ♀, sp. n.

Type (male) from Malay Cove, Ceylon, 3. 3. 92.

Type (female) from Trincomalee, Ceylon, 24. 2. 91 (*Lt. Col. Yerbury*), 1892, 192.

A small species very similar in appearance to *N. inornatus*, sp. n., but distinguished by the pubescence and bristles on the legs and absence of bristles on fore femora.

Length, ♂ 13, ♀ 15 mm.

Male.—Moustache is almost wholly black, a few white hairs only present. Præsutural bristles are black and three in number, two supra-alar, three postalar, all black; the dorso-central bristles more numerous, all black, with fine, long, black hairs intermingled, and a *Machimus*-like crest of fairly long hairs on anterior median line of thorax reaching the dorso-central bristles; *scutellum* with four very long black bristles, also intermingled with fine, long, black hairs. *Abdomen* bluish black in colouring, with the same design as in *Neoitamus inornatus*; the bristles at sides chiefly black; genitalia stout, black, and shining, with black pubescence. *Legs* blackish; the tibiæ reddish yellow, black at apices; tarsi with the first joint reddish yellow, the remaining joints black; the fore femora have no bristles, but long black hairs on underside and a few silvery-white hairs on outer side; the middle femora with the same, but short black bristles are present on the uppersides and one at apex; the hind femora are the same; the fore tibiæ have conspicuous, very long, black hairs on the outer side intermingled with shorter ones, and three short weak black bristles on upperside of the base; pubescence short and black; the middle and hind tibiæ with short black hairs, strong black bristles, and black pubescence, on the hind pair rufous below; tarsi with all the numerous bristles black.

Female is dirty and not in good condition, but appears identical, the ovipositor including the sixth and seventh segments of abdomen.

Neoitamus grandis, ♀, sp. n.

Type (female) and three other females from Bhowali, Kumaon, 5700 feet, July 1909 (A. D. Imms).

A species rather similar in appearance to *Neoitamus longistylus*, Wlk., but distinguished at once by the black femora. *Abdomen* brownish, deusely covered with yellowish-grey tomentum and yellow pubescence. Moustache yellow. *Legs* reddish yellow; femora partly black.

Length about 22 mm.

Face covered with greyish-yellow tomentum and with some yellow hairs at sides; tubercle very large, covered with the moustache, which consists of long, yellowish-white, bristly hairs. *Palpi* black with yellow hairs. *Antennæ* blackish, the first two joints with black hairs. *Forehead* brighter-coloured than face, with some black hairs. Beard yellowish white, the hairs round head the same colour till they reach the black occipital bristles. *Thorax* covered with yellowish tomentum (type is denuded) and with the usual brown stripes, the median one large, not divided. Præsutural bristles three, stout, black; supra-alar bristles three, postalar bristles four; dorso-central bristles about twelve in number, in the type some of the bristles near wings are yellowish; pubescence on dorsum black. *Scutellum* with greyish-yellow tomentum and four stout bristles on margin, yellow in the type, black on the others; some long yellow hairs on dorsum. *Abdomen* with the five first segments yellowish; the ovipositor composed of the last three segments is blackish. *Legs* reddish yellow; the fore femora with a broad black stripe on their upperside in the type, in the other females wholly black; no bristles below, but one black one on the inner side at apex, and long black bristly hairs at the base on underside, some of these are almost as stout as bristles; middle tibiæ incrassate, with numerous black bristles on their lower sides and some yellow ones on their outer sides, two yellow ones near apex, sometimes black; hind femora with two yellow ones near apex, one black one inside near apex, and black bristly hairs below; the pubescence on femora chiefly yellow; tibiæ reddish yellow with black bristles and black pubescence, some fulvous hairs below; tarsi reddish, black at the apices, with many black bristles. *Wings* large, clear, veins reddish, the small transverse vein at about the middle of the discal cell.

Neotamus hindostani, ♂ ♀, sp. n.

Male (type) from Dharmoti, Kumaon, 8. 6. 1912.

Female (type) from same locality, 9. 6. 1912; and other males and females from Shum Ket, 15. 5. 1912; and Bhowali, July 1909, and 20. 6. 1912 (Imms Coll.).

A typical, well-defined, medium-sized species, yellowish grey in colour with dark brown spots on the abdomen, and stripes on the thorax; tibiæ reddish yellow. Moustache yellowish.

Length, ♂ 17, ♀ 19 mm.

Male.—*Face* silky yellowish, tubercle darker. Moustache thick, yellowish. Beard yellowish. *Palpi* black, with yellow hairs. *Antennæ* blackish brown, the first two joints with black hairs, the arista of third joint as long as the joint. *Forehead* darker than face with some black hairs. The hairs round head pale yellowish, meeting the postocular bristles, which are black. *Thorax* with the usual black-brown stripes; præsutural bristles four, two large and two smaller; supra-alar three, postalar three to four; dorsocentral bristles ten to twelve, not so stout, long fine black hairs are intermixed with these, and the pubescence on the dorsum is short, black. *Scutellum* with five to seven black bristles on its margin and long yellow hairs on its dorsum. *Abdomen* ashy grey, covered by a large dark brown spot on each segment; the segmentations paler, the first segment with many long yellow hairs and a few yellow bristles; these are continued on the sides of the other segments, with about four stout yellow bristles on the posterior border at side of each segment, as far as the fourth segment. *Genitalia* large, black, a little red below, with black pubescence. *Legs* black, the tibiæ yellowish red, darker at their extreme apices; the fore and mid coxæ with dense white hairs; the fore femora with white short pubescence and some long, fine, black and yellow hairs below; the middle femora with four rows of short stout bristles at the base below and on the sides, and two or more weak yellow bristles at the apex; the hind femora with four yellow short bristles on the upper side and two near the apex, two weak small black ones at apex, below are long yellow hairs and weak yellow bristles with one or more black bristles intermixed; tibiæ and tarsi with black bristles, the tibiæ with pale yellow short pubescence on the sides, the middle and hind pair with black pubescence on the inner sides; the fore tibiæ with two or three long, weak, black bristles. *Wings* clear, the grey

shading at apex and on hind border not very distinct, but extending down the fore border as far as the junction of the second and third veins; the small transverse vein is just beyond the middle of the discal cell or at the middle.

Female identical. The hind femora appear to have only two or three yellow bristles on their uppersides. The ovipositor consists of the last three segments and is black with chiefly black pubescence.

Neotamus inornatus, ♂ ♀, sp. n.

Type (male) and type (female), from Mussoree, U.P., India (*J. E. Middleton*), 1911, 448.

One female from Punjab (Dudgrou Coll.), 1904, 232.

A small inconspicuous-looking species. Abdomen blackish with segmentations and sides grey. Legs blackish; tibiae and tarsi largely yellowish. Beard black and white. Fore femora with some bristles.

Length, ♂ 14, ♀ 16 mm.

Male.—*Face* blackish with grey tomentum; the tubercle large shining black, carrying a thick, tuft-like, white moustache surrounded by black bristles. *Palpi* black with black bristles. Beard white. *Antennæ* broken off, in the other female they are blackish, the base of the third joint reddish yellow. *Forehead* with black bristly hairs, the hairs round head white, with strong black bristles at vertex on each side of the frontal incision. *Thorax* covered with greyish tomentum, having a very distinct median black stripe divided in the middle and with three blackish spots forming side-stripes; the pubescence is short and black. *Præsutural* bristles are four, three being yellow; three supra-alar bristles, four postalar bristles; the dorso-central bristles are numerous but weak, many being yellowish, weak, bristle-like hairs. *Scutellum* covered with grey tomentum and with some long white pubescence, and three or four black bristles on its posterior border. *Abdomen* covered with greyish tomentum, leaving a large blackish-brown spot on each segment, rounded at their posterior border; on the side of each segment are two or more strong yellow bristles and long white hairs; on the dorsum the pubescence consists of very short yellowish hairs, more numerous and longer and paler on the first segment. *Legs* blackish; the femora at their apices yellow; tibiae yellow with apices black; tarsi yellowish with black apices; fore femora incrassate, with three short yellow bristles at base below and a few black small bristles round the apex; pubescence blackish with some white hairs, all

short; the middle femora with three or four yellow bristles above and six or so below, pubescence of short black hairs, the posterior pair with more numerous yellow bristles above and below; the fore tibiæ with yellow bristles on each side and short black hairs; the middle tibiæ with the same, but two on the underside are longer and stouter, and those on the hind pair are stout and numerous; the tarsi with numerous black bristles, some-yellow ones on the first three joints of the front and middle tarsi. *Wings* (absent). *Genitalia* very short and stout, black.

Female is identical, the white hairs of moustache largely replaced by black bristles. *Thorax* with the same number of bristles, though only three præsutural bristles seem present, two or three of them being yellow; on the other female some of the alar bristles are yellow. *Abdomen* rather blacker, the ovipositor including the sixth and seventh segments is long, more than half the length of the other segments together. The bristles on the underside of fore femora are largely black, on the tibiæ black and yellow, on the tarsi chiefly black. *Wings* clear, very faintly shaded at apex and on posterior border, the small transverse vein this side of the middle of the discal cell.

Neoitamus nigrinus, ♂ ♀, sp. n.

Type (male) and type (female), from Cape Engano, North Luzon (*J. Whitehead*), 98, 207.

This handsome species must be allied to Wulp's species, *N. spinicauda* and *melanopygus*, both from Celebes. It is deep black, the male with silvery-white tufts of hair on the last two segments of abdomen, and the female has a reddish-yellow ovipositor.

Length, ♂ 20, ♀ 22 mm.

Male.—*Face* black with golden-yellow, tomentum chiefly on its lower part. Moustache golden yellow below, black above. *Palpi* black with black hairs. *Antennæ* blackish, the third joint dull rufous. *Forehead* with black hairs; at vertex black bristles round the head continued as yellow hairs to the proboscis. *Thorax* black with traces of three grey tomentose stripes, sides with a dull yellow tomentose stripe. Præsutural bristles two in number, (?) one supra-alar bristle, three postalar bristles, and very many black long hairs represent the dorso-central bristles. *Scutellum* black with black hairs and four or more black bristles on its posterior border. *Abdomen* deep black with black pubescence, which is thick at the sides and on the segmentation; the

hairs on the sixth segment are tuft-like and yellowish, those on the seventh segment shorter, whiter, and less numerous, not tuft-like. Genitalia stout, complicated, black, with black pubescence. *Legs* black, the fore and middle tibiae dull rufous; femora appear devoid of bristles, but have black pubescence, thick on the hind pair; the tibiae have black bristles and black hairs, the latter long below, and some rufous short hairs are present on the fore and middle pair; tarsi black with black bristles and black hairs, the first joint incrassate and long, very heavily armed with black bristles. *Wings* yellowish grey, shaded grey at apex and on posterior border, the small transverse vein this side of the middle of discal cell.

Female is identical, but has no pale hairs on the sixth and seventh segments of abdomen; the ovipositor is reddish yellow, including the sixth and seventh segments, and as long as the three last segments together, at its apex with a few weak, yellow, short spines and hairs. *Wings* are more yellow in colour.

Nesitamus pulcher, ♂ ♀, sp. n.

Male (type) from Kandy, Ceylon, 20. 5. 92. (*Lt.-Col. Yerbury*), 1892, 192.

Female (type) from Haragam, Ceylon, 1. 6. 92. (*Lt.-Col. Yerbury*), 1893, 192; and another female from Kandy, 20. 5. 92 (*Lt.-Col. Yerbury*), 1892, 192.

A large fine-looking species with reddish-yellow antennae and legs. Abdomen black with narrow reddish-yellow bands in the male and yellowish bands in the female. *Wings* shaded at apex and on hind border.

Length, ♂ 22, ♀ with ovipositor 25 mm.

Male.—*Face* chamois-yellow, with tomentum of same colour. Facial tubercle very large, carrying the moustache composed of stout yellow bristles, four or more black bristles above the mouth on each side. *Palpi* reddish brown with yellow hairs. *Antennae* pale yellow, the second joint redder, the third joint wanting, black hairs on sides of the first joint which is fully four times as long as the second joint, the black hairs are also present on this joint. Hind part of head with yellow bristle-like hairs, continued as soft hairs to proboscis and below it. *Thorax* blackish brown with yellow-grey tomentum, the median stripe very distinct, continued just beyond the suture where it splits in half. Pre-sutural bristles apparently two, one being reddish, the other black; supra-alar bristles apparently two and both black;

postalar bristles two, one being black, the other reddish; dorso-central bristles not apparently present, with the exception of a few weak, bristle-like, reddish hairs which are also present on sides posteriorly. *Scutellum* reddish, darker anteriorly, with two or more weak reddish bristles. *Abdomen* blackish brown with narrow fulvous bands; dorsum covered with yellowish tomentum and with short reddish-yellow hairs, which on the anterior borders of the fulvous bands become more like short bristles redder in colour; sides of thorax with one long yellowish bristle on each segment interspersed with long yellow hairs; underside blackish brown with the fulvous bands, almost bare of pubescence. *Genitalia* blackish brown, about as long as the last segment. *Legs* reddish yellow, the knees blackish. Fore and middle femora with eight or more black bristles below and three stout ones on their upper inner sides; hind femora with only two black bristles and reddish hairs below, two dark reddish bristles above near the apex; tibiæ with one or two isolated reddish-yellow bristly long hairs and with yellowish hairs below; tarsi with stout black and reddish bristles; pubescence on legs short, black. *Wings* large, as long as the abdomen, greyish; the dark shading distinct, extending nearly to the fork of the third vein and continued on the posterior border to the fifth posterior cell; the posterior fork of third vein has an abrupt curve inwards; the small cross-vein is beyond the middle of the discal cell.

• *Female* identical. The bristles near the mouth are yellow, not black. *Antennæ* with the third joint yellowish, not so long as the first joint, bearing a black a.ista almost twice its length. All the bristles on *thorax* are black; the dorso-central bristles are fairly numerous, but many of them are weak, short, bristle-like hairs. *Scutellum* is almost wholly reddish yellow, with black bristles. The light bands on the *abdomen* are yellower; the ovipositor is black, composed of the seventh and following segments, about as long as the fifth and sixth segments together. Fore femora with only four very strong black bristles, situated on the underside and interspersed with weak long black hairs, these are also present on the middle femora, with seven more on the upper-side; on the hind femora five bristles below and eight on the upperside, besides two at apex; the fore and middle tibiæ have three very long, strong, black bristles on the underside and a few shorter stout ones above; the hind tibiæ have one near the base and two pairs beyond, with two weak hair-like bristles on the outer side; the pubescence on the underside of tibiæ and on the dorsum is yellow, elsewhere on the legs

short and black; the first joint of the tarsi has thick yellow hairs on the under surface. The shading of the wings at apex does not extend quite so far.

This species differs from the typical species of the genus, the ovipositor including only the seventh segment, not the sixth, and the genitalia of the male are very unobtrusive and simple; it approaches the genus *Cinadus* in having a strong bulge on the posterior branch of the third vein, but cannot be included in that genus, the genitalia being too small and the ovipositor not conical. For the present it is left in the *Neoitanus* genus.

Neoitanus rubrofemoratus, ♂ ♀, sp. n.

Type (male) and other males, type (female) and other females; all from Tientsin, 15. 6. 06 (*F. M. Thomson*), 1907, 200.

A large species in the same group as *N. involutus*, Wlk., *N. grandis*, *hindostani*, *tarsalis*, and *nigrinus*, sp. n., but distinguished by the almost wholly reddish-yellow legs, the femora with very indistinct black stripes; the ovipositor of the female determines the generic place, however. Antennæ reddish. Abdomen black with grey bands.

Length, ♂ 21-22, ♀ 23-25 mm.

Male.—Face covered with yellowish tomentum; the tubercle large, but not very prominent, carrying a yellow-haired moustache. *Palpi* black with pale yellow hairs. Beard yellowish white. *Antennæ* with the first two joints black, the second red at apex, and third wholly red. Hind part of head with the usual strong black bristles, in the centre with yellow hairs, which also are present on the lower sides. *Thorax* covered with greyish-yellow tomentum and with dark black-brown stripes, the median one hardly divided in the centre, the side-stripes short; pubescence chiefly black, very distinct on the median stripe, reaching to its anterior border; two præsutural bristles, two supra-alar, and three postalar bristles, all long and black; the dorso-central ones numerous, but the bristles are much weaker. *Scutellum* same colour as thorax with two long black bristles. *Abdomen* with a rounded, large, blackish-brown spot on each segment; the sides and posterior borders grey. Genitalia very large, the underpart proceeding from below the last segment with a large black clasper on each side and a central yellowish curved process, the black part with black hairs, the upper part also large, black, with black hairs. *Legs* reddish yellow; the femora black at the base and at apex, often with an

indistinct black stripe, all the bristles on legs are black, very numerous on the tarsi; femora almost bare, the posterior pair with a few. *Wings* pale brownish, clearer at the base, and often with clear kernels in the cells; the small transverse vein beyond the middle of the discal cell.

Female identical; the ovipositor long, including the sixth and seventh segments.

Neotanus siamensis, ♂ ♀, sp. n.

Type (male) from Biserat, Siam, 9. 8. 1901 (*H. C. Robinson and N. Annandale*), 1916, 21.

Type (female) from K. Mabek, Siam, 13. 7. 1901.

Another male and female from Biserat.

Another male from Sungkie, Siam, 10. 2. 1902; all by the same collector, 1916, 21.

Another female from You Boi, Hainan, 5. 6. 04; 1911, 288.

A small black species with wide grey segmentation on the abdomen. Antennæ and legs black, the tibiæ partly chamois-yellow in colour.

Length, ♂ 15, ♀ 17 mm.

Male.—*Face* blackish covered with grey tomentum; the tubercle distinct. Moustache consists of chiefly white bristles, two or three black ones intermixed. *Palpi* black with yellow hairs. *Antennæ* blackish, the first two joints with bristly black hairs. *Forehead* with the same; at vertex head with some strong black bristles, white hairs continued round head. *Thorax* blackish with grey tomentum, leaving the median black stripe distinct, narrowly divided, and three greenish-black spots at sides, the posterior one very small; pubescence on dorsum black. Præsutural bristles black, two in number; three supra-alar bristles, and two postalar bristles; the dorso-central bristles represented by weak, bristly, black hairs, some very long. *Scutellum* covered with grey tomentum, and with white hairs, and two stout black bristles on its posterior border. *Abdomen* with the dark spots deep black, becoming brownish at sides; the grey segmentations are continued up the sides, becoming more golden yellow at base of segments; pubescence short and black on the dark spots, whitish and long on the segmentations and at sides. Genitalia stout and complicated, black with black pubescence, and some reddish hairs on the upper piece. *Legs* blackish; the tibiæ pale reddish yellow on their outer sides; fore femora with no bristles, but with some scattered white hairs, the middle pair the same, but the

white hairs are longer and more inclined to be bristly, and two black bristles are present on the apex, also present on the hind tibiæ, which have an extra black bristle on the upper-side; fore tibiæ with black bristles and long black hairs below, and a thick fringe of short rufous hairs below; the middle pair the same with fewer black bristles and the long hairs are white; hind tibiæ with black bristles and the fringe of rufous hairs on each side, and no long hairs below; the first joint of tarsi stout and elongate with many stout black bristles; some white pubescence on outer side and rufous hairs below, and some long black hairs; the other tarsi studded with black bristles and with some black pubescence. *Wings* clear, shaded on the apex and posterior border, the small transverse vein situated on apical third of the length of discal cell.

Female identical. Moustache with more black hairs. Ovipositor is very long, including the sixth and seventh segments, about as long as the four posterior segments together.

Neoitamus tropicus, ♂ ♀, sp. n.

Male (type) from Sat Tal, 9. 5. 1912.

Female (type) from Sham Ket, 16. 5. 1912; and another from Bhowali, July 1903, 5700 feet—all from Imms Coll.

A small species, very similar to the European *Neoitamus cyanurus*, but differing in the bristles on legs being largely yellow, and in the presutural bristles being reddish yellow or yellow and three in number.

Length, ♂ 10, ♀ 13-15 mm.

Male.—Greyish black. *Face* covered with whitish tomentum; the tubercle which takes up the greater part of the face darker, covered by the dense dirty-white hairs of the moustache with some black bristle-like hair above them. *Palpi* black with black hairs. Beard dirty white. Hairs round head the same colour; postocular bristles black. *Antennæ* blackish, the arista not so long as the third joint. *Thorax* with the usual black stripes, the median one divided; the three presutural bristles yellowish, two supra-alar bristles usually black, two postalar (one black, one yellow); the dorso-central bristles extend beyond the suture in two rows, all black; pubescence on the dorsum black, white at the sides. *Scutellum* with four stout long bristles on its margin, and white pubescence on the dorsum. *Abdomen* with the usual large black spot on each segment and long white hairs on the first segment, elsewhere short and white, sides with some

white bristles and hairs. Genitalia small, stout, black with black hairs above and some yellow below. *Legs* black, the knees of the femora and the tibiæ, except at their apices, reddish yellow; tarsi the same, blackish at the apices of the joints; fore femora with two short yellow bristles above and some below intermixed with yellow hairs, middle femora the same, hind femora with four above and four or more long ones below, pubescence on all short and white; tibiæ with only white bristles and chiefly yellowish pubescence; fore tarsi with some white bristles and black ones, the other pairs with fewer white ones. *Wings* clear, shading in apex hardly visible, small transverse vein beyond the middle.

Female identical. The fore femora have black bristles below, and the fore tibiæ a long row on their uppersides. Ovipositor, composed of the last three segments, black.

Neotamus tarsalis, ♂ ♀, sp. n.

Male (type) from Kandy, Ceylon, 28. 5. 92 (*Lt.-Col. Yerbury*), 1892, 122.

Female (type) from Bentota, Ceylon, 13. 6. 91 (*Lt.-Col. Yerbury*), 1892, 122.

Two males from Trincomalee, 10 miles Kandy Road, same collector, 30. 5. 91 and 30. 8. 91.

One male from Baduella, Ceylon, 5. 6. 92, same collector.

A species not unlike in general appearance *N. pulcher*, sp. n., but at once distinguished by the broad first joint of fore tarsi armed with very stout bristles. *Legs* reddish yellow; femora largely black; knees and apices of tibiæ and the tarsi black. *Antennæ* black. *Abdomen* black, with broad grey segmentations.

Length, ♂ 18-19, ♀ 24 mm. with ovipositor.

Male.—*Face* covered with silky yellow tomentum and hairs. Moustache on the not very prominent tubercle, composed of whitish-yellow, long, weak bristles. *Palpi* black with yellow hairs, in the type some black bristles are present on the moustache. *Antennæ* blackish, the first two joints with black bristly hairs; the arista nearly double the length of the third joint, which is tinged reddish brown and is a little longer than the first joint. *Forehead* with black bristly hairs at the sides and on the central tubercle, hairs round the head white, four or five very stout black bristles are present each side of the frontal incision. *Thorax* covered with yellowish tomentum and with a distinctly marked median black stripe divided in the middle and two large blackish spots on each side; dorsum covered with short

black pubescence. Præsutural bristles are very large and stout, two in number, one supra-alar bristle only and three postalar bristles; the dorso-central bristles are only represented by some fine black hairs on each side and in the middle, those on the posterior part becoming bristly hairs; the dorsum is covered with fine black hairs and some longer pale yellowish ones posteriorly and on the sides. *Scutellum* covered with grey tomentum and with six blackish bristles on its posterior border, in the other males some of these appear yellow; dorsum with pale yellowish pubescence. *Abdomen* with large brownish-black spots on each segment, produced posteriorly, but not reaching the hind border which is covered with greyish-yellow tomentum forming a band on each segment continued up the sides; dorsum covered with short yellowish or white hairs and with the same at the sides; underside largely brown. *Legs* reddish yellow; the fore and middle femora black at the base and apex, the hind pair blackish for two-thirds of their length with a black apex; the tibiæ with dark apices; the middle and hind tarsi wholly brownish; the fore femora with no bristles, some long soft hairs below, the middle pair with two stout black bristles at the apex, the hind pair with five on the upperside and four or so below, and two stout ones at the apex; the tibiæ with five or more black bristles on the upperside of the fore pair, and a crown of them at the apex; underside with long, soft, yellowish hairs; the middle pair with rather fewer bristles on the uppersides and no soft hairs below, the hind pair with four or so on the upper and under side and four at the apex; the underside with a thick fringe of short yellowish hairs, also present on the upperside, these are present but less noticeable on the middle tibiæ; tarsi with the first joint enlarged and broad on the front pair and longer on the other pairs, on these last it is nearly as long as the four other joints together, all with numerous very stout black bristles at apex and on the underside, and with some yellowish hairs above, the other joints have fewer bristles; pubescence on the legs is otherwise short and black. *Wings* not so long as the abdomen. *Genitalia* are large, with black hairs, some white ones on the apex. The other males appear identical, the bristles and colouring of legs being the same, but the abdomen has a more hoary pubescence.

Female is identical. The bristles on the scutellum all black. Ovipositor very long, including the sixth and seventh segments, nearly as long as the first five segments. *Legs* not quite so dark; the fore femora with four or five weak

long bristle-like hairs below, besides the long soft hairs; the bristles on the hind pair of femora do not appear to be so numerous; fore tarsi are enlarged as in male. *Wings* as in the male are shaded at apex and on posterior border, and the small transverse vein is before the middle of the discal cell.

Neoitamus neavensis, ♀, sp. n.

Type (female) and five others, from 150–200 miles W. of Kambore, Congo Free State, 3500–4500 feet, 16. 10. 07 (S. H. Neave), 1907, 230.

A small black and grey species not unlike *Neoitamus sodalis*, Wulp, from Aden, according to the description, having no hairs or bristles on the scutellum; but Wulp makes no mention of the black stripe on the femora.

Length 17 mm.

Face covered with yellowish tomentum. *Moustache* scanty and yellow. *Palpi* black with yellow hairs. *Antennæ* (broken off), the first joint black with dark hairs. *Forehead* with some black hairs at sides. *Thorax* covered with greyish tomentum, leaving apparent a very distinct velvety black median stripe divided anteriorly; the side-stripes are represented by two large black spots and a small one; the two præsutural bristles are stout, black; the supra-alar consist of one stout one and a weaker, the postalar being similar; the dorso-central bristles are weaker and few in number. *Scutellum* grey, with no signs of bristles or hairs. *Abdomen* with large black velvety spots and grey segmentations, the sides are also grey, the first segment has a tuft of yellowish hairs at sides; pubescence on dorsum very short and chiefly dark; the ovipositor includes the sixth and seventh segments and is about as long as the four preceding segments. *Legs* slender, reddish yellow; the fore femora blackish on their upperside; tibiæ black at apices, the tarsi brownish from the second joint onwards, the middle femora also have a dark stripe, the hind pair are only black at their apices; only the middle and hind femora have bristles and then only two at the apex, with some very short pale yellow pubescence; the tibiæ have three or four each, one near the base with the same pubescence; the first joint is heavily armed with stout black bristles, most of them underneath, and the following joints also have them. *Wings* clear, grey, the small transverse vein is situated beyond the middle of the discal cell towards the apex of the wing.

Neotamus africanus, ♀, sp. n.

Type (female) and two other females from edge of forest on S. and E. slopes of Kenya, 6600-7000 feet, Brit. E. Africa (S. A. Neave, Feb. 3-12, 1911), 1911, 177.

A large blackish species, measuring about 22 mm., distinguished by the wholly black moustache. Tubercle of face large, but not reaching the antennæ. *Thorax* with not very numerous black bristles on its dorsum; the præsutural bristles consist of two very stout ones and two finer ones. *Scutellum* has six or more bristles on its posterior border. *Abdomen* (somewhat denuded) appears blackish with chiefly black pubescence, a few yellow hairs are apparent at sides and on the segmentations; ovipositor long, including the sixth and seventh segments, in length about equal to the three preceding segments together. *Legs* black, apices of fore femora reddish; tibiæ almost wholly reddish, as are the basal joints of the fore and middle tarsi; the fore tibiæ have a thick short fringe of rufous hairs on their lower side, the middle and hind pair have hardly any long hairs; pubescence elsewhere black, with stout black bristles. *Wings* pale brown, clear at base, the discal cell almost wholly clear; veins dark brown, the small transverse vein beyond the middle of the discal cell.

HELIGMONEURA, Bigot.

Thoms. Archiv. Entom. ii. p. 356 (1853).

Mochtherus, Loew, Linn. Ent. iv. p. 58 (1849) [proce. Schmidt, Goebel Coll., 1846].

Neomochtherus, Ost.-Sack.

Oriental and Australian Regions.

This genus is very slightly represented in these regions.

Wulp described three species under *Mochtherus*, viz., *Heligmonaura gnava*, *patruelis*, and *striata*, from the Indian Archipelago, Java, and the Celebes, and one species *H. lauta* from New Guinea. In the *Annals & Mag. Nat. Hist.* 48) xi. p. 423 (1913), I removed *Asilus lascus*, Walker, to this genus, a species recorded from New Zealand.

Two new species are now described.

Heligmonaura gnava, V. d. Wulp.

Tijd. v. Ent. (2) vii. (xv.), p. 242 [*Mochtherus*] (1872).

Females from Kandy, Ceylon (*E. E. Green*) 1910, 415,

and from Khasi Hills, Assam, 97, 82; from Biserat, Siam (Robinson and Annandale), 1916, 21; and from Sandakan, British N. Borneo (D. Cator), 98, 83.

H. striata is distinguished from the above by not only the hind knees being black, but the posterior femora at apices and below and the posterior tibiae and tarsi are all blackish; the antennae are also blackish.

In *H. gnava* and *H. patruelis* they are yellowish, and the legs in the latter are more like those of *H. striata*. *H. laeta*, described from a male only, is a large species, 16–22 mm.; legs almost entirely reddish yellow.

Heligmoneura indianus, ♂ ♀, sp. n.

Male (type), female (type), and two other females from Katagiri, 6000 feet, S. India, (F. Cragg). A medium-sized species, yellowish grey in colour, the legs almost wholly yellow. Moustache composed in the middle of long bristle-like yellow hairs, surrounded by several longer black bristles. Antennae blackish brown. Wings clear, shaded at apex and narrowly so on the posterior border.

Length, ♂ 13, ♀ 17–18 mm.

Female.—Face covered with silky-looking pale yellowish tomentum; tubercle small, covered by the moustache, which is continued on the sides of the epistome. Palpi black, with pale yellowish hairs. Antennae blackish brown, the first two joints with black hairs; the arista of third joint nearly as long as the joint. Beard pale yellowish; hairs round the head the same colour, reaching the postocular bristles, which are few in number and black. Forehead darker than the face, with black bristly hairs on each side. Thorax with a distinct median brown stripe divided in the middle; dorsum of thorax with small bristles and a row of longer ones on each side of the stripe; praesutural bristles, supra-alar, and postalar bristles all two in number; the dorso-central bristles about six in number, with finer hair-like bristles intermingled. Scutellum with two black bristles on its margin and some fine long yellow hairs between. Abdomen yellowish grey or yellowish brown, the segmentations narrowly paler in colour, the yellow bristles weak and few in number; some appressed brighter-coloured pubescence on dorsum, thickest on the apical segments, elsewhere short and black; ovipositor black, almost as long as the fourth, fifth, and sixth segments together. Legs yellowish red, with fine but numerous black bristles; fore femora with only soft yellow hairs, mid-femora with at least seven strong black bristles, hind femora with

three very strong black bristles and other smaller ones; pubescence on the legs short, black; on the under edges of the tibiæ some reddish-yellow hairs are distinct. *Wings* with the small transverse vein beyond the middle of the discal cell.

Male is discoloured and damaged, but is no doubt the same species, though the femora appear almost destitute of strong black bristles, and some on the fore tibiæ are yellow; genitalia not very large, black.

Teligmoneura sinensis, ♂ ♀, sp. n.

Type (male) and type (female) from Tientsin, 25. 6. 06 (F. M. Thomas), 1907, 200, and another female.

A fair-sized blackish-brown species with paler segmentations on the abdomen and legs wholly reddish yellow. *Antennæ* yellowish. Moustache composed of yellow bristles. *Wings* clear, shaded at apex and on posterior border.

Length, ♂ 15-20, ♀ 17 mm.

Male.—*Face* covered with silky-yellow tomentum; the sub-rele distinct, covered by the yellow moustache. *Palpi* black, with long yellow hairs. Beard yellowish. *Antennæ* yellowish, the third joint wanting in all the specimens. *Forehead* a little darker than the hind part of head with stout, not very long, yellow bristles. *Thorax* dark, with yellowish-grey tomentum, leaving a broad median blackish undivided stripe, with long yellowish bristles on the posterior part and short black pubescence on dorsum; the præsutural bristles two in number, one yellow, one black; one supra-alar and two postalar, all yellow. *Scutellum* with two yellow bristles. *Abdomen* covered with dense yellowish-grey tomentum, leaving a median dark stripe composed of long or triangular spots; yellow bristles on each segment, two or three in number, more numerous on the first segment; dorsum covered with yellow short pubescence. Genitalia chestnut-coloured, stout, and not very long with some short yellow pubescence. *Legs* reddish yellow, the bristles on the tibiæ yellow, with a few black ones intermixed. Femora somewhat incrassate, with chiefly black bristles; tarsi darker at their apices, with black bristles; the pubescence on legs short, yellow, dark on the outer sides of the tibiæ and on their dorsum. *Wings* with both branches of the fork of the third vein slightly curved.

Female similar. The ovipositor black, quite as long as the last two segments, the small transverse vein in the middle of the dorsal cell.

South African Region.

The species of *Heligmoneura* described from this region are: *Heligmoneura annulitarsis* and *sinuata*, Loew, from Caffraria; *H. deserticola*, Karsch, from E. Africa; *H. monobia*, Speiser, from Erythrea; *H. nuda*, Bezzi, from Erythrea; *H. modesta*, Bigot, from Gaboon; and *H. rothkirchii*, Speiser, from Kamerouns. None of these species are represented in the Brit. Mus. Coll., except *H. sinuata*. *H. annulitarsis* must be nearly allied to it, but the fork of the third vein is said to be only very slightly curved, and the hind and middle tibiæ with only black spots. The ovipositor is larger than the last two segments of abdomen—not equal, as in *H. sinuata*.

Length 10 mm.

H. deserticola is described very shortly; the face with two rows of very black bristles down the middle, a characteristic not very probable in a species of this genus. *H. monobia* is described as a black species with yellow legs. *H. nuda* is described by the author as very like an *Ommatius* species, and, as he had not seen any specimen with perfect antennæ, the question of genus remains undecided. *H. rothkirchii*, Speiser, from Duala, Kamerouns, is described as a very fine species, 20½ mm. long. Blackish with the ordinary yellow-grey tomentum of Asilidæ; the pubescence on the abdomen yellow, long at the sides. Palpi black, red-haired. Antennæ reddish yellow. Legs yellowish; the femora at apices, most of the tarsi, and the hind tibiæ black; described from one female specimen.

Three new species are here described.

Heligmoneura sinuata, Loew.

Dipt. Süd-Afrika, p. 168 (1860).

Males and females from Malvern and Howick, Natal (*J. P. Cregoe* and *G. A. K. Marshall*).

A small species with almost wholly yellow legs, only black at extreme apices of posterior femora and tibiæ. Moustacæ yellow and black. Scutellum with two black bristles. Abdomen brownish with yellowish tomentum. Wings with the posterior fork of third vein very distinctly curved.

Length 13 mm.

Heligmoneura neavii, ♂ ♀, sp. n.

Type (male) from N.E. Rhodesia, vicinity of Chambesi, 4060 feet, 18. 5. 1908 (*S. A. Neave*).

Type (female) from same locality, 16. 5. 1908 (*S. A. Neave*). Other males and females from Sualaba River, 2500–4000 feet, 19. 4. 07, etc. (*S. A. Neave*), 1907, 230, and males from Kambove, Katanga, 4000–5000 feet, 2. 4. 07 (*S. A. Neave*), 1907, 230.

A species with a dusky or yellowish-brown abdomen, wholly yellowish-red legs and antennæ, white moustache, and genitalia of male bright reddish yellow.

Length, ♂ 16–17, ♀ 16–18 mm.

Male.—*Face* black, covered with yellowish or white tomentum in well-preserved specimens. Moustache composed of numerous white bristles and often two or more black bristles. *Palpi* black, with yellowish bristly hairs. Head yellowish. *Antennæ* yellowish red with some black hairs on the first two joints. Occipital bristles on head yellowish, continuing as finer whiter hairs round head to beard. *Thorax* in type discoloured black and red, but in other specimens covered with yellowish-brown tomentum and with two faint narrow brown stripes; presutural, supralar, and postalar bristles all two in number and black, as are the few central and side bristles; dorsum also covered with some fine blackish hairs. *Scutellum* same colour as thorax, with two black bristles. *Abdomen* blackish, but covered with yellowish-brown tomentum, with strong yellow bristles on the posterior borders of segments and below; dorsum with rather thick, fine, short, yellow and black pubescence. *Legs* with chiefly stout black bristles, yellow ones are present on the apices of fore tibiae and on the under surface of the other tibiae, and on the fore tarsi, also below the femora, which are devoid of the stout black bristles on the front pair, having only weak yellow bristles below; pubescence on legs chiefly consists of short black hairs, some yellow ones on sides of tibiae, especially the hind pair. *Wings* clear, with small transverse vein beyond the middle of the discal cell, the posterior branch of the third vein with a very pronounced bend in the middle. Genitalia of male are long, with black fine hairs.

Female is identical, the black bristles on moustache at upper part and sides are always present and more numerous, but the yellow bristles on the legs are less numerous and hardly present on the fore legs; the ovipositor is black, not so long as the last two segments together.

Heliomoneura africanus, ♀, sp. n.

Type (female) and two others, from Magadi, Brit. E. Africa, April 1912 (*F. G. Hamilton*), 1915, 37, 1.

A yellowish-brown species with blackish antennæ, white and black moustache, reddish-yellow legs with black stripes on the tibiæ; ovipositor short and black, not including the seventh segment.

Length $13\frac{1}{2}$ –14 mm.

Face covered with dirty yellowish-white tomentum; tubercle distinct; moustache composed of white bristles with half a dozen or so fine black bristles above. *Antennæ* dark-coloured, both the two basal joints with strong black bristles and hairs, the third joint is wanting in all the specimens. *Forehead* with yellow tomentum and with black bristles on each side. Occipital bristles black, hairs round head white. *Beard* white. *Palpi* black with white hairs. *Thorax* blackish brown covered with yellowish tomentum and with two distinct dark brown stripes and shorter side-stripes; pre-sutural, supra-alar, and postalar bristles all black and two in number, central bristles long and stout with short bristles running up to the shoulders; pubescence chiefly consists of short black hairs. *Scutellum* with two long white bristles. *Abdomen* blackish brown, covered with yellowish-grey tomentum, with yellowish bristles on posterior borders of segments at sides and below, and with short yellow pubescence. *Legs* with black stripes on all the femora on the inner dorsal surface covered with fine white pubescence, and with yellow bristles at apex and below; tibiæ blackish at apex, with yellow bristles; tarsi largely black with black bristles; pubescence on legs black and short. *Wings* clear, the posterior branch of third vein with only a very moderate curve, small transverse vein about the middle of the discal cell.

Heligmoneura natalensis, ♂ ♀, sp. n.

Type (male) from Marley Kloof, Natal, and others from Natal and Mfongosi, Zululand.

Type (female) from Karkloof, Natal, Feb. 1897 (*G. A. K. Marshall*), 1903, 17, in Brit. Mus. Coll., and other females from Natal; and Mfongosi, Zululand (*W. E. Jones*).

A species differing from *Heligmoneura africanus* by the black bristles on the scutellum and black bristles on the legs; it is also larger on the whole.

Length, ♂ 16–17, ♀ 14–18 mm.

Male.—*Face* dark, covered with whitish tomentum; the tubercle bearing black bristles above and yellowish ones below, forming the moustache, with short black bristles below. *Palpi* black with black hairs. *Beard* scanty, white. *Antennæ* black. *Forehead* the same as face, with black

bristly hairs. The bristles on hind part of head black. *Thorax* dark, covered with grey tomentum, with two very distinct, narrow, blackish-brown, median stripes and duller greenish spots at sides; præsutural bristles two in number; the supra-alar and postalar respectively three in number, all black and very stout; median posterior bristles also stout and numerous. *Scutellum* same colour as thorax, with two black bristles. *Abdomen* brownish black, covered with greenish-grey tomentum, very noticeable yellow bristles at sides of each segment, and the dorsum covered with short black pubescence; a stouter row of black bristly hairs on the posterior borders of segments, which also appear paler in colour; genitalia small, black and shining, with black pubescence. *Legs* reddish yellow, with a black stripe on all the femora and the two posterior pairs with black hairs; the posterior tibiæ darker at apices and the tarsi all darker at the joints; all bristles black with the exception of two or three long yellowish bristles on the fore and middle tibiæ at apices and at the bases of the first tarsal joints; pubescence short, black, some longer white pubescence on the underside of the fore femora and some short yellow pubescence on the outer edges of the tibiæ and first tarsal joints. *Wings* clear, grey at apex and on hind border, the posterior fork of the third vein slightly curved, the small transverse vein beyond the middle of the discal cell.

Female identical, the yellow bristles on the legs not always present; ovipositor, which does not include the seventh segment, is about the length of the last two segments together.

VII.—Batopora (Bryozoa) and its Allies.

By ARTHUR WM. WATERS, F.L.S., F.G.S.

[Plate VI.]

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As several interesting points have turned up relating to *Batopora* and its allies, it seems better to publish an account at once, without waiting for the publication of a paper,

now ready, dealing with species growing in a cupuliform shape, including Selenariadæ and Conescharellinidæ, as the consequences of war may cause delay.

The re-examination of some specimens of what Haswell described as *Sphærophora fossa* show the importance of this species in throwing light on certain fossils. The zoaria are small, and were described as subspherical "with a circular pit at the upper pole," but it does not seem that we must speak of the pit being at the upper pole. The growth is towards the pit, a fact correctly shown by Haswell, although he does not allude to it (Pl. VI. fig. 1). Another form with zoaria about the same size, described by Reuss* as *Diplotaxis placentalis*, now changed by Gregory† to *Biselenaria*, as the name *Diplotaxis* was preoccupied, grows on one surface to the border and then turns over to the other growing towards the centre. Although the growth in the two forms considered is not quite identical, they partially explain one another. Canu‡ in describing *Biselenaria affinis*, Greg., says the zoœcia radiate from a "grande ansestrule," which, however, is not shown in Canu's figure, and, as the zoœcia are Membraniporidan, it is difficult to understand.

The importance of the pit was appreciated by Haswell, who did not attempt any explanation in his first paper, but in a subsequent one§ he mentions a *Cellepora* with minute Actinids lodged in cylindrical pits, excavated in the substance of the polyzoarium. He thinks this may throw some light on the pits of *Sphærophora fossa*, and described it as a case of symbiosis of Actinid with *Cellepora*. However, as regards *S. fossa*, the definite position of this pit in recent species from various localities, as well as in fossils from many localities, makes this very improbable; nor is this all, for it is clear that what was described as "aufrecht stehende Zelle" or "primordial Zelle" by Reuss and others in *Batopora* and some allied genera is a similar pit, though much smaller. In both cases there is a raised ridge surrounding the border (Pl. VI. fig. 6), and there are in the pits large pores leading to the surrounding zoœcia. Reuss, who had seen the tubes from these pores, spoke of them as a hydrostatic system, but how he considered that the system functioned is not clear. Canu|| and Bassler also refer to a hydrostatic system.

* Bry. des deutsch. Unterolig. Sitz. d. k. Akad. Wissen. Wien, lv. p. 231, pl. ii. figs. 5-7 (1864).

† "Brit. Pal. Bry.," Trans. Zool. Soc. London, vol. xiii. p. 234 (1893).

‡ "Bry. Tert.," Ann. de Paléont. vol. ii. p. 30 (1907).

§ Proc. Linn. Soc. N.S. Wales, vol. vii. p. 608 (1882).

|| Early Tert. Cheil. Bry. p. 73: Smithsonian Inst. U.S. Nat. Mus. Bull. 96 (1917).

The pit in the common *Batopora multiradiata* is found to continue through the two layers, for the mature zoarium consists of two or more layers, as described by Reuss and as figured by me* (see also Pl. VI. fig. 4). As the mature *multiradiata* is two-layered, we should be able to find an earlier stage, and to do so I again searched through material from different places where it occurs, and in most cases found a small globular *Batopora*, which is what I determined as *B. stoliczkai*, Rss., though what were taken to be appendages are probably young zoecia in course of formation and are not always found, and then there seems to be no material difference from *B. rosula*, Rss., so that perhaps *rosula* and *stoliczkai* are synonyms. The possibility of a globular *Batopora* being the first stage was foreseen by Reuss and also by me, but at that time was rejected.

The primary is well within this globular form. I have found a very similar pit in *Orbitulipora lenticularis*, Rss., from Montecchio Maggiore, but in a very different position—namely, near the periphery directed towards the middle of the zoarium, and in *Orbitulipora petiolus* one has been figured by Dixon† and by Gregory‡ at the side. On p. 92 it is seen to be continuous from the centre to the circumference of the zoarium. MacGillivray§ and Mapleston|| speak of there sometimes being more than one pit in *S. fossa*, but I have seen nothing of the kind. Perhaps they had found a true *Cellepora*. Is there any other explanation of these pits, except the perforating Actinoid? The large pores in the pits, with their tube or chamber leading to the zoecia (Pl. VI. figs. 3, 4), is undoubtedly a point of much importance, and the explanation now offered is that these pores indicate the attachment of radicles, which together form a solid bundle such as we know in various Bryozoa¶.

The shape of the oral aperture (0.12 mm.) and of the

* North Ital. Bryozoa, p. 33, figure in text; Quart. Journ. Geol. Soc. vol. xlvii. (1891).

† Geol. & Fossils of Tert. & Cret. Form. of Sussex, p. 151, pl. i. fig. 10 (1850).

‡ Brit. Pal. Bry. pl. xxxi. figs. 12, 13.

§ "Tert. Poly. of Vict.," Trans. R. Soc. Vict. p. 108 (1895).

|| "New or little-known Polyzoa," Proc. R. S. Vict. vol. xxv. p. 361 (1913).

¶ Preparations had been made, and the drawings for Plates completed, before I had an idea of any theories of Canu and Bassler. In a short letter from Canu, he seems to have come to the conclusion that *Conesarchelina* and some other genera lived with the apex of the cone below, and were attached, as partly suggested by d'Orbigny. I see that there will be points of agreement between us, but I am awaiting their complete work.

zoecia, as well as the ovicell would, if considered alone, place *Sphaerophora fossa* with *Holoporella*, a genus which I separated from *Cellepora*.

A specimen of *Stichoporina reussi*, Stol., from Latdorf, given to me by Dr. Pergens, has a pit as described, and the zoecial opening as first seen is round or slightly oval, but on looking down the peristome the lower edge of the oral aperture is found to be nearly straight (0.08 mm.) and this is also the case in *Batopora* (text-fig. 1, f, g).

Although there are these similarities between *S. reussi* and *Batopora multiradiata*, the underside of *S. reussi* shows the zoecial shape and is not filled in, also the early growth must have been different. In my specimen of *reussi* the zoecia near the pit are raised, whether because they are larger or because a second layer is commencing cannot be decided from the specimen—at any rate, the inner raised zoecia are directed towards the pit, while the outer ones are directed away from it. Canu* has united *S. reussi* and *Batopora multiradiata* as one species, which does not seem to be the case, nor will they probably remain in the same genus. Canu says "unilamellaire," but *B. multiradiata* is bilamellar. This examination shows that Koschinsky was not right in uniting his species of *Stichoporina* with Stoliczka's, for none of Koschinsky's have a pit, besides which, the oral aperture of Koschinsky's species is much larger with a distinct contraction at each side, so that *S. simplex*, *S. protecta*, *S. crassilabris*, and *S. bidentata*, Rss., must be placed elsewhere, and they seem to agree with *Mamillopora*, Smitt.

Neviani† published a paper on *Stichoporina*, though now most species referred to seem to belong to the genus *Mamillopora*. The reason for separating them from *Stichoporina* has been given, and in none other than Neviani mentions is there a pit. *Fedora edwardsi*, Jull., is a hollow cylinder, as are also *Kionidella* (*Discofustrellaria*) *dactylus*, d'Orb., and *F. excelsa*, Kosch., though with a small lumen, and both seem to belong to *Mamillopora*.

Canu‡, speaking of *Stichoporina reussi*, Stol., says "ancestrale membraniporoide," but are we yet correctly acquainted with the ancestrale?

The genus *Prattia*, d'Archiac, I should place under *Mamillopora*, though Canu§ has left it as *Prattia*, and

* Bry. Tert. p. 100.

† "Nuova sp. foss. di *Stichoporina*," Bull. Soc. Rom. per gli Stud. Zool. vol. iv. p. 1 (1895).

‡ Bry. Tert. p. 100, pl. xi. figs. 16-18 (1907).

§ "Bry. du Sud-Ouest de la France," Bull. Soc. Géol. de France, ser. 4, vol. x. p. 854 (1910).

Faura and Canu* have done the same. Canu has refigured d'Archiac's specimens, and it will be seen that the zoëcia differ but very slightly from *Mamillopora* (*Stichopora*) *simplex*, Kosch., although the avicularium is much larger, also the *Fedora glandulosa*, d'Arch., as figured by Canu, looks much like *Mamillopora crassilabris*, Kosch., and I should place it under *Mamillopora*.

Mamillopora (*Ascosia*) *pandora* †, Jullien, belongs to this genus or to the family. The barrel-shaped zoëcia are erect, and, as seen in a specimen given to me by Jullien, the appendages are not vibracular but avicularian, with a distinct bar and a prolonged mandible. The three supra-oral processes remind us of those of *Mamillopora crassilabris*, Kosch.

Héjjas has described as *Batopora aviculata*, H. †, a species with a large triangular avicularium, like those of *M. simplex*, &c., below the oral aperture, but in the light of present investigations it is doubtful whether we must place it under *Batopora* or *Conescharrellina*. He also makes a new genus *Batoporella* for a bilaminate form otherwise much like *Batopora*. Although he refers to the figure of it, there is none in my copy, and on the cover only two plates are referred to; evidently something has gone wrong about the plates, as the references do not correspond with the plates, and this is referred to as pl. v. fig. 13, though if it has been published it must have been on a plate vii.

Batopora multiradiata, Reuss.

(Pl. VI. figs. 4, 5, 6, 9, 10.)

Batopora multiradiata, Reuss, "Die foss. Anthoz. und Bry. der Schichtengruppe von Crotaro." Denk. math. naturwiss. Classe der k. Akad. der Wissenschaft. Wien, vol. xxix. pp. 265 & 292, pl. xxxi. figs. 1-4 (1869); Pergens, "Bry. foss. de Kolosvar," Bull. Soc. Roy. Malac. de Belgique, vol. xxii. p. 7 (1887); "Foss. Bry. von Wola Lutzanska," Bull. Soc. Belge de Geol. vol. iii. p. 72 (1887); Waters, "North Italian Bryozoa," Quart. Journ. Geol. Soc. vol. xlvii. p. 32, figure in text (1891).

We have already learnt (p. 82) that the zoëcia, in mature zoaria, occur in two or more layers and the stage with only

* M. Faura & F. Canu, "Sur les Bry. des Terr. Tert. de la Catalogne," Inst. Catalana d'hist. natural. p. 100, fig. 12 (1918).

† "Drag. du Trav.," Bull. Soc. Zool. de Fr. vol. vii. p. 505, pl. xiii. figs. 13, 14 (1882); Calvet, Exp. Sc. du Trav. et Talisman, vol. vii. p. 441 (1907). Bisk named a specimen of this species *Cellepora abyssicola* in M.S. from the Atlantic, 780-1095 fathoms ('Porcupine,' 997.1).

† Héjjas, Emerich, "Beit. z. Kennt. der Tertiären Bry. Siebenburgens," Sitz. Med. Naturwiss. Section des Siebenburgischen Museumsverein, vol. xvii. p. 214, pl. iv. fig. 11 (1894).

one layer has been called *Batopora stoliczkai*, Rss.*, and in very many localities both the first and mature stage have been found together. In sections, as in Pl. VI. fig. 4, the two layers are clearly seen, and also the interesting fact that the so-called "primordial Zelle" passes through the two layers. This has now to be called a pit, and is homologous with the pit in the *Spharophora fossa* of Haswell. There are numerous tubes from the neighbouring zoecia passing to the pit, and these were well seen during the preparation of the section; also in *S. fossa* the large pores in the pit were seen to pass into minute chambers in the zoecia (Pl. VI. figs. 2, 3).

Reuss considered that the colony grew from this pit, but he had missed some points of structure, though, from a manuscript left relating to *B. rosula* and which Manzoni† published, he clearly understood that there were two layers in a mature form. Koschinsky seems to have considered that the conical form grew first and then became globular, but this is reversing the process.

I think that one of the small zoecia in the centre of the first stage is the primary, and also in *S. fossa* the primary was probably some distance from the pit. The base of the cone may also be covered by a secondary zoecial growth. The base of the cone usually shows the one row of radiating zoecia, but I have one specimen showing two rows (Pl. VI. fig. 5).

B. multiradiata is usually 2-3 mm. in diameter, sometimes showing the second layer as a cap (Pl. VI. fig. 4a); this outer layer is very irregular, being by no means always at the apex, in one the edge of the cap ends near to the pit. I have collected it mature from Brendola, Val di Lonte, Montecchio Maggiore, Priabona, Malo, Ferrara di Monte Baldo, Creazzo near Lonigo, Vilmezzano, Mazzurega, and the earlier or *stoliczkai* stage from Brendola, Val di Lonte, Montecchio Maggiore, Creazzo, Malo, Spiassi.

The base of the cone has the zoecia arranged radially, just as in *Conescharrellina*, and between the two genera there are only secondary differences on this surface, though in *Conescharrellina* we are unaware of any case of the two layers, nor is there any pit, though there seem to be cases of

* Reuss was very near this idea, for, speaking of *B. multiradiata* from Val di Lonte, he says no other form is found and we cannot therefore hold it for a higher form of *Batopora*. Since then I have found many specimens of *B. stoliczkai* from Val di Lonte.

† "Bri. foss. del. Mioc. d'Aust. ed Ungh.," Denkschr. math. natw. Ak. der Wissensch. Wien, vol. xxxvii. p. 6, pl. ii. fig. 6 (1877).

several large pores probably serving the same purpose; but in spite of the very great similarity of form of growth *Conescharrellina* has a much smaller oral aperture, with a trace of a sinus and muscular attachments some distance from the border, while *Batopora* has a nearly straight proximal edge with contractions at the side, as in most *Lepralia*, as the genus has been understood.

Orbitulipora and *Sphærophora*, both of which have a somewhat similar pit (large in *Sphærophora* and lateral in *Orbitulipora*), have much larger oral apertures than either *Batopora* or *Conescharrellina*, and have a nearly straight proximal edge and large curved distal end, just as in *Holoporella*; further, *Conescharrellina* has small cells with semilunar s'its, whereas none are known in *Batopora*. *Conescharrellina* has regular elongate chambers within the cone (Pl. VI. fig. 8), and these were clearly formed after the outer layer of zoecia, whereas in *Batopora* the irregular chambers are zoecial chambers formed before the outer barrel-shaped zoecia.

The small *Cellepora globularis*, Reuss, from Val di Lonte, is readily mistaken for *Batopora multiradiata*, as small specimens are about the same size, though the zoecia are larger and have two peristomial avicularia. This small globular form was evidently seen by Reuss* from Val di Lonte, but he and others have united under that name larger growths, without proof that they are the same species.

Also, *Conescharrellina eocæna*, Neviani †, which occurs from several places in the Veneto, may at first glance seem to be *Batopora*, but examination of various characters and of the internal structure proves it to be *Conescharrellina* (see Pl. VI. fig. 8).

Loc. Val di Lonte and Priabona (*Rss.*), Pap Patak; Pap Falvi Patak; Pap Falva, Kolos Monostor, Bács Szucsag, Wola Lu'zanska, and Ofener Mergel (Hungary (*Perg.*)), Eocene of Bavaria, and found by me from Val di Lonte, Brendola; Priabona; Montecchio Maggiore; Ferrara di Monte Baldo; Malo; Creazzo; between Sarego and Grotte near Lonigo (Vicentine); Mazzurega, near Fumane, Veronese (abundant in this locality); S. Urbano di Mt. Sgreve (Vicentine).

* Bry. Crosaro, p. 264 (52)

† This is the *Batopora conica*, Hantken, as proved from a specimen in the British Museum sent by Hantken, and this is interesting, for though Hantken often refers to it, yet it is not known whether he has described it. This species is dealt with in my other paper.

Mamillopora simplex (Koschinsky).

Stichoporina simplex, Koschinsky, "Bry. der ält. Tert. des Süd-Bayerns," *Paleontographica*, vol. xxxii. p. 64, pl. vi. figs. 4-7 (1885); Kirkpatrick, "Hyd. & Poly. Torres Straits," *Proc. Roy. Dublin Soc.* vol. vi. p. 623, pl. xvii. figs. 4 a, b, c, d (1890); Waters, "North Ital. Bry.," *Quart. Journ. Geol. Soc.* vol. xlvii. p. 31, pl. iv. figs. 16-18 (1891); de Angelis d'Ossat, ed. A. Neviani, "Corall. e Bri. Neog. di Sardegna a." *Bull. Soc. Geol. Ital.* vol. xv. p. 16 (1897).
Mamillopora smitti, Calvet, *Exp. Sc. du Trav. et du Talisman*, Bry. vol. viii. p. 424, pl. xxvii. figs. 4, 5 (1907).

There are four species called *Stichoporina* in the North Italian Tertiary Beds, differing principally in the position and character of the avicularia. In *S. simplex*, K., there is on one side above the oral aperture a large triangular avicularium, though very occasionally one on both sides. Koschinsky thought that the avicularium was below the oral aperture, though his figure would suggest its being above, apparently he mistook the zoecium to which it belonged. The second species, *S. protecta*, Kosch., has, as described by Koschinsky, a small round avicularium ("knopf-förmiges—mit rundlicher Öffnung") at each side. This small avicularium, according to Canu*, may be pointed.

The third species (*Cupularia*) *bidentata*, Rss., has a small round avicularium at the distal end of the zoecium, and the ovicell is very wide, wider than figured by Reuss. Canu also considers that what I determined as *S. simplex*, Kosch., is the *S. protecta*, K., but he seems to have overlooked the fact that Koschinsky mentioned and figured a large triangular avicularium at the side of the oral aperture in *S. simplex*. *S. crassilabris*, Kosch., from near Lonigo, Vicentine, has a projection above the oral aperture, often with a large central process or two lateral ones.

In neither of the four species mentioned have I seen a central pit, nor is one mentioned, while in (*Stichoporina*) *reussi*, Stol., which is the type, there is a distinct one, as figured by Stoliczka, and it is very marked in a specimen from Lattdorf sent by Pergens. Other differences are mentioned on page 82.

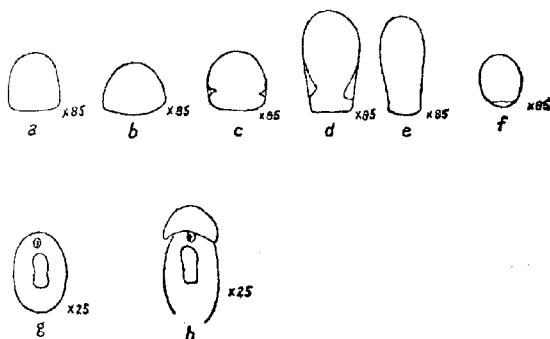
The oral aperture of *S. reussi* is much smaller (about 0.08 mm.) than that of the *M. bidentata* group, in which in the wider part the oral aperture, contracted at the side by a denticle, is about 0.12 mm. It is thus seen that the group just mentioned does not correspond with *S. reussi* and must be placed under *Mamillopora*, Smitt. Whether *S. reussi* should be placed with *Batopora* we may leave open.

* Bry. Terr. Tert. des Env. de Paris, p. 101 (1907).

Canu* united *Stichoporina reussi*, Stol., and *Batopora multiradiata*, Reuss, but it does not now seem that this can be maintained.

The North Italian specimens of *simplex* are 5.8 mm. diameter with the dome very little raised. Kirkpatrick's are 20 mm. and Calvet's have a more elevated cone, but I do not think that they should be separated on these grounds.

Fig. 1.



- a. Oral aperture of *Sphaerophora fossa*, Haswell. $\times 85$.
 b, c. Do. *Orbitulipora lenticularis*, Rss. $\times 85$.
 d, e. Do. *Mamillopora bidentata*, Rss. $\times 85$.
 f. Do. *Stichoporina reussi*, Stoliczka. $\times 85$.
 g. Zoecium of *Stichoporina reussi*, Stoliczka. $\times 25$.
 h. Do. *Mamillopora bidentata*, Rss. $\times 25$.

Loc. Götzreuth, Bavaria (*Kosch.*), and in my collection from Brendola; Priabona; Ferrara di Mt. Baldo; between Grotte and Sarego, near Lonigo; all in the Veneto: and living from Murray Island, Torres Strait (*Kirkp.*); also Cape of Good Hope and Malacca (*K.*); Saint Vincent, Cape Verde Islands, 21 met. (*Calvet*).

Mamillopora bidentata (Reuss).

(Pl. VI. figs. 7, 11; text-fig. 1, d, e, h.)

Cypularia bidentata, Reuss, "Pal. Stud. über die älteren Tert. der Alpen," Denk. Akad. Wiss. Wien, vol. xxix. p. 277, pl. xxix. figs. 1, 2 (1869); Pergens, Bry. Foss. des Euv. de Kolosvar, p. 7 (only in list) (1887).

* Bry. Tert. Ann. de Paleont. vols. ii.-iv. p. 100, pl. xi. figs. 16, 17, 18.

Reuss's figure was difficult to understand, but there is no doubt that specimens in my collection are this species, and also on further cleaning up the specimen from Pap Falvi Patak sent by Pergens the characters can be made out. The zoœcia are raised, the oral aperture is straight below and is contracted at each side, so that of course the aperture was filled by the operculum, whereas in *Cupularia* the opening is opesial. At the distal end of the zoœcium there is an appendage, but whether avicularian or vibracular it is difficult to say, though probably avicularian. The opening to this appendage is apparently round, but details cannot be deciphered.

There is no pit and the primary is a small zoœcium surrounded by six zoœcia (Pl. VI. fig. 7).

The ovicell is very wide and raised, similar to what I figured* in *Fedora excelsa*, Kosch., and is placed beyond the avicularium—a position so far from the oral aperture is difficult to explain.

Loc. Val di Lonte and Grancella (*Rss.*), Eocene of Hungary; Pap Patak; Pap Falvi Patak; Marne de Buda (*Pergens*), Rocca di Sciesa, Colle Berici, and Malo, Vicentine (*A. W. coll.*).

Mamillopora crassilabris (Koschinsky).

Stichoporina crassilabris, Koschinsky, *Bry. Süd-Bay.* p. 66, pl. vii. figs. 1-4 (1855).

A specimen of *Mamillopora* from between Grotte and Sarego, near Lonigo, Vicentine, has a great thickening above the oral aperture, sometimes rising in one or three processes, the middle one of which is an avicularium or vibraculum, and it looks like the appendage of *M. bidentata* very much enlarged and erect. No other appendage is visible, but the state of the fossil is not satisfactory. A small specimen of *M. simplex*† from Brendola has a thickening above the oral aperture, also a large triangular avicularium by the side. There are six zoœcia round the primary and further cleaning recently has enabled better study. May not this thickening occur in various species of the group under certain conditions?

Loc. Götzreuth (*K.*), between Grotte and Sarego.

* "N. Ital. Bry.," *Quart. Journ. Geol. Soc.* vol. xlvii. p. 29, pl. iv. fig. 6 (1891).

† *Loc. cit.* fig. 18.

Sphærophora fossa, Haswell.

(Pl. VI. figs. 1-3; text-fig. 2, a.)

Sphærophora fossa, Haswell, "Poly. from Queensland Coast," Proc. Linn. Soc. N.S. Wales, vol. v. p. 42, pl. iii. figs. 5, 6 (1880); "Note on a Curious Instance of Symbiosis," *op. cit.* vol. vii. p. 608 (1882).

Cellepora fossa, Waters, "Foss. Cheil. Bry. S.W. Australia," Quart. Journ. Geol. Soc. vol. xxxvii. p. 343, pl. xviii. fig. 80 (1881); *op. cit.* vol. xxxviii. p. 275 (1882); *op. cit.* vol. xxxix. p. 426 (1883); *op. cit.* vol. xli. p. 307, fig. 2 (1885); MacGillivray, "Tert. Poly. of Victoria," Trans. R. Soc. Vict. vol. iv. p. 108, figs. 8, 9, 10 (1895); Maplestone, "Tab. List Cheil. Poly. in Vict. Tert.," Proc. R. Soc. Vict. vol. xvii. n. s. p. 215 (1904); "New or Little-known Poly.," Proc. R. S. Vict. n. s. vol. xxv. p. 361 (1913).

? *Cellepora tubulosa*, Busk.

On re-examination of the fossil specimen from Curdies Creek, I find that the growth commences on the part opposite to the pit, it then grows over to the under-side, in which the pit is situated, a mode of growth which we have seen occurs in Reuss's *Diplotaxis*, so that when we are looking at the pit it is at the completion not the beginning of the zoarium. A similar pit, though much smaller, has been described as the "primordial Zelle" in *Batopora* and other genera (see page 80).

Haswell described the zoarium as subspherical, slightly depressed, with a circular pit at the upper pole, a description quite describing specimens from Queensland, which he kindly sent to me, as one side is somewhat flattened and the pit is at the opposite pole; but in some fossils* from Batesford or Muddy Creek the surface with the pit is the flatter, showing the zoœcia directed to the pit (Pl. VI. fig. 1), and these are the best preserved of any specimens, recent or fossil, examined by me. In these the pit is 0.55 mm. in diameter, and from Percy Island the six specimens have pits 0.8 mm., 0.6 mm., 0.55 mm. In *Batopora multiradiata*, Rss., the pits are much smaller, being 0.25-0.27 mm. from Ferrara di Monte Baldo, Brendola, Montecchio Maggiore, and Val di Lente; a pit in *Orbitulipora petiolus* measures 0.36 mm.

Batopora was described as with a single "aufrecht stehende Zelle." This so-called "primordial Zelle" also in *Sphærophora* stands out surrounded by a border, and is much larger than any of the zoœcial openings, but we must now call it a pit and this is referred to on page 80. This reversal of the position of the zoœcia, though not quite the same as now known in *Conescharrellina*, yet reminds us of that genus.

* "Foss. Chil. Bry. from Muddy Creek," Quart. Journ. Geol. Soc. vol. xxxix. p. 426 (1883).

It seems as though both in *Spharophora* and *Butopora* the zoecia have grown over the primary in all directions, and this we see in *Orbitulipora excentrica*, Seg. (see page 92), and in *O. petiolus*.

The ovicell of *Spharophora* is large, round, raised, and open in front.

Referring to the two specimens from Batesford or Muddy Creek, it is well to recall the fact that Haswell mentions a form with a flat base without giving it a name. The fossil *Cellepora serrata*, MacG., also has a flat base and clearly belongs to *Spharophora*.

Loc. Holborn Island, Queensland (H.); Percy Island, Queensland, 11 fath., sent by Haswell; N.E. coast of Australia, sent by Brazier; South Australia (*Maplestone*).

Fossil. Curdies Creek, S.W. Victoria; Mt. Gambier; Atlinga and River Murray Cliff (all A. W. W.), Schnapper Point, Bird Rock, Corio Bay, Waurin Ponds (all MacG.), Cape Otway, Spring Creek, Muddy Creek, Shelford, Fyansford, Mornington, Mitchell River (*Maplestone*).

Orbitulipora excentrica, Seguenza. (Text-figs. 2, a, b, c.)

Orbitulipora excentrica, Seguenza, "Le Formaz. Terz.," Atti Reale Accad. dei Lincei, ser. 3, vol. vi. p. 130, pl. xii. figs. 22, 22a (1879); Neviani, "Bri. neog. delle Calabrie," Pal. ital. vol. vi. p. 188, pl. xvii. figs. 15, 16 (1900).

Orbitulipora excentrica, var. *flabellata*, D'Ossat & Neviani, "Coral. e Bri. Neog. di Sardegna," Boll. Soc. Geol. Ital. vol. xv. p. 18 (1897).

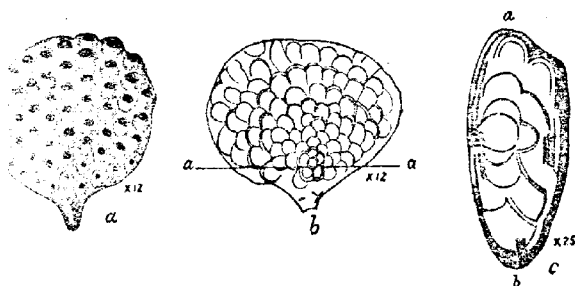
I had written a description of specimens from Mazzurega as *O. excentrica*, nov., before remembering that Seguenza had described a species with this specific name, which, although larger and with more zoecia than the Mazzurega fossils, is apparently the same species. Mine are about the same size as Neviani's var. *flabellata*. There are several specimens from material collected from Mazzurega, near Fiumane in the Veronese, N. Italy, sent to me by Professor Parona. The age was considered Bartonian, but is now called Priabonian. The bilaminate depressed zoaria are small, about 2-3 mm. in diameter, with a stalk (as it has been called in *O. petiolus*), from which the zoecia spread out in fan-shaped form, more or less in rows. The stalk or pedicle is for attachment, as is the case with the pits of *Butopora* and *Orbitulipora*, and it sometimes gives a subtriangular appearance to the zoarium.

The zoecia are very distinct and rounded, as seen from above, and in the younger ones the aperture occurs about the centre of the apparently nearly round erect zoecia,

while in the larger older zoœcia the aperture has a nearly straight proximal border, below which there is sometimes a large avicularian chamber. It is, however, as a rule, very difficult to see the shape of the oral aperture, so that, although outlined by the camera lucida, the restoration of some of the apertures has been necessary.

This is very closely allied to *O. petiolus*, Lonsdale *, and he, Stoliczka †, Reuss ‡, Vine §, and Gregory ||, all show the central zoœcia the smaller, and speak of the zoœcia radiating from the centre of the zoarium; also the text and figures indicate that it is depressed, which is not the case in the North Italian fossils, nor is it always so in the specimens of *petiolus* which I have examined. Various authors have referred to an ovicell in *O. petiolus*, but it is spoken of as

Fig. 2.

*Crinitulipora excentrica*, Seg.

a. $\times 12$. b. Longitudinal section. $\times 12$.
c. Transverse section near base. $\times 25$.

proximal to the oral aperture, whereas it is distal and directed towards the centre of the disk.* In my specimens of *excentrica* no ovicells are distinguished, though some zoœcia have a large suboral avicularium.

Horizontal sections of *excentrica* are extremely interesting, as they show the primary very near to the stalk, referred to as the pit in *Sphærophora*, *Batopora*, and *Stichoporina*. The

* Dixon's 'Geology of Sussex,' p. 151, pl. i. fig. 10 (1850).

† Olig. Bry. von Latdorf, p. 91, pl. iii. fig. 5 (1861).

‡ Bry. d. deutschen Unterolig. p. 217, pl. i. figs. 1, 2 (1867).

§ Vine, "Notes on Brit. Eoc. Poly.," Proc. York. Geol. Polytech. Soc. vol. xi. p. 164, pl. v. fig. 10 (1889).

|| "On the Brit. Palæog. Bry.," Trans. Zool. Soc. Lond. vol. xiii. pt. vi. p. 253, pl. xxxi. fig. 12 (1893).

round primary is surrounded by five zoëcia, and then from these the ordinary zoëcia grow, so that there are zoëcia all round the primary, and I have already suggested that the first zoëcium of *Batopora* was not very far from the pit, formerly mistaken for a "primordial cell." The section, text-fig. 2, *c*, was made to show the central zoëcia at right angles to text-fig. 2, *b*, and the relationship of the zoëcia on each side. Text-fig. 2, *c*, is magnified about twice as much as text-fig. 2, *b*, and is from about the line *a-a*, text-fig. 2, *a*. A series of transverse sections are required to completely understand the growth, but this is not possible.

There is in *O. petiolus* a pit to the younger zoaria, and as growth proceeds this is prolonged, so that in mature zoaria there is a tunnel from the centre to the large external pit, and this can in places be seen through the layers of zoëcia covering it. Sections show this tube more clearly from the centre to the projection, and inside this tube fairly large pores occur in regular lines.

Some of the specimens in the British Museum, marked *Heteropora glandiformis*, Gregory*, are young *O. petiolus*, and in one case a pit can be seen. Besides this there are one or two which, though worn, show signs of a base like that of *Conescharrellina cancellata*, Busk (figure 22 in a paper now ready). The specimens, being mounted, could consequently not be examined all round, but in none was I able to distinguish Cyclostomatous characters.

Reuss thought that the process of *petiolus*, subsequently called stalk, pedicle, or pit, had no connection with the structure of the zoarium, and was only accidental, but we now see that it is the prolongation of the pit.

O. petiolus, Lonsd., occurs from beds of about the same age as the Mazzurega deposit, having been found by Dixon from Bracklesham, by Stoliczka from Latdorf, by Reuss from the Lower Oligocene of Calbe and Bünde; Vine says from Barton Bay; Bracklesham; Stubbington; Gregory besides these mentions Bramshaw and Brook; Vincent and Th. Lefèvre† say it occurs in Belgium from the Bruxellian, Laekenien (Upper Eocene), Weismelien and Tongrian (Oligocene), subsequently also referred to by Moulton; Canu mentions it from the Bartonian of Var in the Paris basin.

Loc. of e. centrica. Tortonian (*Seg.*), Mioc. of Calabria

* "British Palaeogene Bryozoa," Trans. Zool. Soc. vol. xiii. p. 261, pl. xxxii. fig. 11 (1893).

† "Faune Laek. sup. des Environs de Bruxelles," Ann. Soc. Malac. de Belge, vol. vii. p. 29 (1872).

and of *Cadreus sopra Bonurra*, Sardinia (Nev.); Mazurrega, Veronese (*A. W. coll.*).

The forms dealt with may be provisionally placed as follows. It is a group with erect, usually barrel-shaped zoecia:—

I. With a pit towards which the zoecia are directed.

1597. *BATOPORA*, Rss.—Oral aperture small (0.09 mm.), nearly round, but examination shows straight lower edge. Bi-laminate. Primary zoecia hidden. Type, *B. stoliczkae*, Rss. (probably young of *B. multiradiata*, Rss.).

1801. *ORBITULIPORA*, Stoliczka.—Oral aperture large, with straight lower edge. Pit at the side. Bi-multilayered. Type, *O. haidingeri*, Stol.

1881. *SPHEROPHORA*, Haswell.—Oral aperture large (0.12 mm.), with straight lower edge. Grows in all directions from the early zoecia. Pit central. Multi-laminate. Type, *S. fossa*, Haswell.

1852. *STRICHOPORINA*, Stoliczka.—Oral aperture small. Uni-laminate to bi-laminate? Pit central. Type, *S. reussi*, Stol.

II. Usually without a pit.

1873. *MAMILLOPORA*, Smitt*.—Oral aperture large (0.12 mm.), contracted at each side. Primary zoecium erect, surrounded by six similar zoecia. Only uni-laminate, showing the position of the zoecia on the under surface. Type, *M. cupola*, Sm. Tertiary fossils: *M. simplex*, Kosch., *M. biolata*, Rss., *M. protecta*, Kosch.

1851. *CONESCHABELLINA*, d'Orb.—Oral aperture very small, slight sinus, opercula with muscles some little distance from the border, semi-lunar slits. Cone uni-laminar, filled in by large chambers. (To be dealt with in the larger paper.) Type, *C. angustata*, d'Orb. (A species fossil from N. Italy has large pores round the apex, and one near the centre is larger and might be called a pit.)

EXPLANATION OF PLATE VI.

- Fig. 1. *Sphaerophora fossa*, Haswell, $\times 10$. Surface with a large pit. The zoecia are shown directed towards the pit. From Batesford or Muddy Creek, fossil.
- Fig. 2. Ditto. $\times 10$. Section showing the pit. From Percy Island, recent.
- Fig. 3. Ditto. $\times 25$. Section of the pit, showing the pores leading to the zoecia. From Percy Island.
- Fig. 4. *Batopora multiradiata*, Reuss., $\times 25$. Section showing the pit and the zoecia in a second layer round the first. From near Novezzina, fossil. (a) $\times 2$. Zoarium showing a cap formed by a second layer of zoecia. From Montecchio Maggiore.
- Fig. 5. Ditto. \times about 10. Base showing two circles of zoecia. This is the only specimen showing two basal circles clearly.
- Fig. 6. Ditto. $\times 25$. Showing the pit with smaller zoecia round it, as well as the ordinary zoecia. From Val di Lonte.

* I have published a figure of the operculum of *Fedora edwardsii*, Jull., in "North Ital. Bry.," Quart. Journ. Geol. Soc. vol. xlvii. pl. iv. fig. 7; and Kirkpatrick has published one of *M. simplex*, Kosch. Proc. R. Dublin Soc. n. s. vol. vi. pl. xvii. fig. 4 (1890).

- Fig. 7. *Mamillipora bidentata*, Reuss, $\times 25$. Showing the primary zoecium and the six surrounding zoecia. From Bocca di Sciesa.
- Fig. 8. *Conescharrellina eocena*, Neviani, $\times 10$. Section from Spiassi, N. Italy.
- Fig. 9. *Batopora multiradiata*, Reuss, $\times 25$. Showing ovicells. From Montecelio Maggiore.
- Fig. 10. Ditto. $\times 10$. Showing the formation of a second layer from the neighbourhood of the pit. From Val di Lonte.
- Fig. 11. *Mamillipora bidentata*, Reuss, $\times 25$. Showing ovicell. From Bocca di Sciesa. (a) zoarium, $\times 3$.
- Fig. 12. *Conescharrellina eocena*, Neviani, $\times 25$. This figure is built up from various parts, as the preservation as a whole is not perfect. From Spiassi.

VIII.—Two new African Freshwater Sponges. By JANE STEPHENS, B.A., B.Sc., National Museum of Ireland.

SEVERAL years ago Dr. Annandale (5) drew attention to the somewhat oyster-like shells of the genus *Ætheria* as affording a favourable standing-place for the growth of freshwater sponges, not only on account of their roughened and often corrugated surface, but also owing to the fact that, like true oysters, their lower valve is firmly fixed to some solid support. Dr. Annandale stated that at least one species of freshwater sponge, *Corvospongilla loricata* (Weltner), had already been described from an *Ætheria* shell, when an examination of the shells belonging to this genus in the collections of the Indian Museum led him to the discovery of two new species of sponges. He remarked that he had little doubt that other sponges would be brought to light if the *Ætheria* shells preserved in museums were carefully scrutinized. Following Dr. Annandale's suggestion, the *Ætheria* shells in the collection of this museum were examined, with the result that two well-marked new species were discovered on one shell, and a few broken gemmules, too fragmentary to identify, on another.

As is well known, the genus *Ætheria* occurs only in Africa and in the north-west part of Madagascar. On the continent of Africa it is confined to the tropics, except that it descends the River Nile to the mouth. Many species have been described from time to time, but the researches of Drs. Anthony and Germain (6, p. 372) have shown that there is only one species—a very polymorphic one, namely *Ætheria elliptica*, Lamarek. Two varieties are, however, recognized by these authors—*Æ. elliptica*, var. *typica*, Germain, a smooth

form from streams and rivers, and *Æ. elliptica*, var. *tubifera*, Sowerby, a spined form from standing water. The fine shell on which the two new species of sponges are growing is spined, and therefore belongs to the latter variety, so that we may conclude that the sponges lived in still water. The locality of the shell is given merely as Benguela.

Shells in the museum collection belonging to the genera *Mulleria* and *Bartlettia* from South America, which with *Ætheria* comprise the family *Ætheriidae*, were examined also, but without any further sponges being found.

The following seven species of sponges have up to the present been described from specimens growing on *Ætheria* shells:—*Spongilla sumatrana*, Weber, vars. α and β , Weltner; *S. ætherica*, Annandale; *S. schubotzi*, Weltner; *Corvuspongilla loricata* (Weltner), *C. micramphidiscoides*, Weltner; *C. scabrispiculis*, Annandale; and *Potamolepis stendelli*, Jaffé. A specimen of *Spongilla carteri*, Bowerbank (fide Kirkpatrick), has also been found on one of these shells.

Weltner (11), in a paper published in the year 1913, gives a complete list of the freshwater sponges known in Africa up to that time. Twenty-four species and varieties are mentioned. Since then Dr. Annandale (5) has described two species and Jaffé (7) one species; these, with the two species now described, bring the total number of African freshwater sponges known at the present time to twenty-nine species and varieties. Thus Africa already compares favourably as regards number of species with other parts of the world known to be rich in freshwater sponges.

Spongilla (Euspongilla) microspiculata, sp. n.

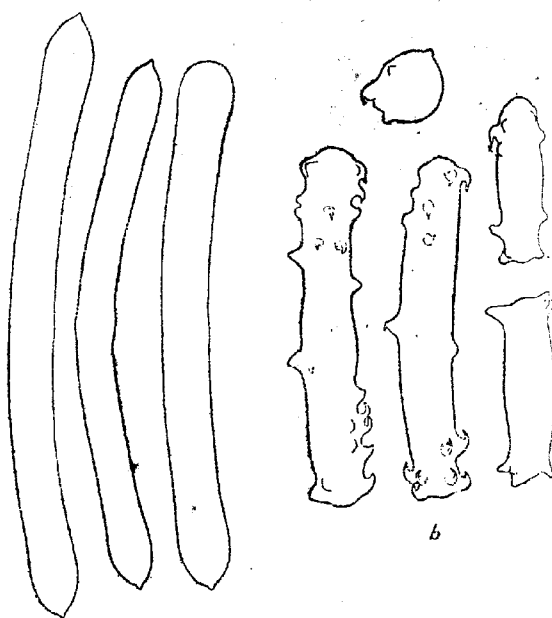
The sponge spreads in a fairly thick encrustation over about a third of the surface of the upper valve of an *Ætheria* shell, and coats some of the spines to their summits.

It is of a greyish-white colour in the dried state and is extremely hard to the touch. The surface is raised up into small ridges and rather prominent spines.

The skeleton is made up of very thick fibres, which consist of multiserially arranged spicules bound together by a considerable quantity of spongin. The main fibres run vertically upwards through the sponge, dividing from time to time, and their extremities project above the general surface of the sponge and form the spines just referred to. They are united by rather thinner fibres at right angles to them, which run only from one main fibre to the next and do not themselves form continuous fibres. The whole constitutes a dense firm network.

The gemmules are numerous. They are spherical and occur singly towards the base of the sponge. They are about 0.55 mm. in diameter. Each is surrounded by a thick coat of spongin. Outside this is a layer of gemmule-spicules, lying two or three deep and densely packed together. The majority are arranged more or less tangentially, but some are placed nearly vertically and project, giving the

Fig. 1.



Spongilla (Euspongilla) macrospiculata, sp. n.

a, oxea, $\times 330$; b, gemmule-spicules, $\times 600$.

surface of the gemmules a shaggy appearance when seen under a low power of the microscope. The foramen is set on a very low tubule, which penetrates the layer of spicules, so that the opening is on a level with the general surface of the gemmule. A few gemmules, either singly or in groups, are

scattered over parts of the shell now, free from the sponge. They are firmly attached to the shell and rest on a dense mass of gemmule-spicules.

Spicules.—The macroscleres are slightly curved, stout, smooth oxea, tapering abruptly at each end to a small sharp point into which the axial canal extends. The spicules are slightly swollen at the ends, and sometimes there is a faintly marked swelling at the centre of the shaft. There are not many abnormal forms present, but some of the spicules are irregularly bent and occasionally one end is rounded off. More rarely both ends are rounded. The macroscleres measure 0.275–0.335 mm. in length and have a thickness of 0.02–0.027 mm. They resemble in some degree the more pointed macroscleres of *Spongilla crassissima*, Annandale, var. *crassior*, Annandale; but they are more swollen at the ends and are somewhat longer and thicker.

There are no free microscleres present in the sponge.

The gemmule-spicules are short, thick strongyla provided with strong spines. Some of the spicules, especially the shorter ones, are swollen in the middle, so that they are barrel-shaped; others are nearly spherical, but still bear a few spines. The spines are grouped at either end of the strongyla, leaving the centre of the shaft smooth, but often a few scattered spines occur along the shaft. The spines are stout; typically they are strongly curved towards the centre of the shaft and end in a sharp point; but many of them are stout, straight, knob-like projections. The spicules measure from 0.035–0.1 mm. in length and have a thickness of 0.012–0.016 mm. Some of the short inflated ones are as much as 0.021 mm. in diameter.

Locality. Benguela; on a shell of *Etheria elliptica*, var. *tubifera*.

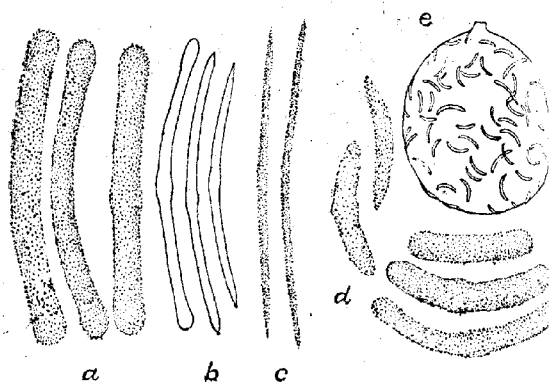
Spongilla (Stratospongilla) benguelensis, sp. n.

The sponge occurs in a number of very small patches towards the edges of the lower valve of the *Etheria* shell on which the previously described species is growing. There are the remains of various other patches of the sponge also on the lower valve in the region of the hinge and one or two minute specimens on the upper valve. These patches of sponge are very inconspicuous, as they run chiefly in the furrows of the shell; in the dried state they are soft to the touch and their surface is even. Scattered over parts of the lower valve of the shell are quite a number of gemmules belonging to this species. Each gemmule is firmly fixed to

the shell by means of the spongin which binds together the cage of macroscleres in which it is enclosed.

The skeleton, as far as can be seen, is a rather close network of spicules. The spongin could not be made out, and it must be very scanty in quantity, as the spicules at once fall apart when a small specimen is sectioned by hand.

Fig. 2.



Spongilla (Stratospongilla) benguelensis, sp. n.

a, strongyla, $\times 330$; b, developing strongyla, $\times 330$; c, microxea, $\times 600$; d, gemmule-spicules, $\times 600$; e, gemmule freed from its cage of macroscleres, $\times 60$.

The gemmules, as already stated, are firmly fixed to the shell by means of the spongin binding the cage of macroscleres which encloses each gemmule. These macroscleres lie tangentially to the surface of the gemmule, they are strongly bound together by spongin, and adhere closely to each other, unlike the rest of the skeleton. The gemmule rests on the floor of the cage, and, at least in the dried state, there is a considerable space between the sides and roof of the cage and the gemmule. Similar cages of macroscleres have been described in other species—for example, in *Spongilla atheria*, Annandale, *Corvospongilla burmanica* (Kirkpatrick), *Corvospongilla lapidosa* (Annandale), and *Corvospongilla scabrispiculis*, Annandale. The gemmules themselves are spherical and are about 0.38–0.42 mm. in diameter.

Each is enclosed in a thick coat of spongin. The gemmule-spicules lie tangentially to the surface, and are embedded in this coat. The spicules are fairly numerous, but are not closely packed together as in the allied species *S. indica*, Annandale, *S. sumatrana*, Weber, and *S. bombayensis*, Carter. There is a short foraminal tubule which lies rather to one side of the gemmule in its natural position.

Spicules.—The macroscleres are slightly curved, uniformly microspined strongyla. The ends are a little swollen and there is often a slight swelling in the centre of the shaft. The strongyla measure 0.13–0.17 mm. in length by 0.01–0.015 mm. Among them are scattered a few slender smooth oxea with a well-marked swelling in the centre of the shaft. These are nearly the same length as the preceding spicules, and are apparently young forms of the macroscleres, as they lead on to thicker spicules which are obviously developing macroscleres and which are nearly cylindrical, but some of which still retain rather pointed ends.

The free microscleres are slightly curved, sharply pointed, microspined oxea measuring 0.06–0.09 mm. in length by 0.0025 mm. Some have a very feeble swelling at the centre of the shaft.

The gemmule-spicules are small, curved, sausage-shaped spicules uniformly covered with minute spines. Sometimes the ends are pointed instead of being rounded off as is usually the case. There is often a slight swelling in the centre of the shaft. The spicules measure 0.035–0.06 mm. in length, with a maximum diameter of 0.003 mm.

Locality. Benguela; on a shell of *Ætheria elliptica*, var. *tubifera*.

The subgenus *Stratospongilla*, Annandale (1), to which the foregoing species belongs, is chiefly tropical in its distribution (4). At the present day it is known to be represented in India by three species—*S. bombayensis*, Carter, *S. indica*, Annandale, and *S. graveleyi*, Annandale; it occurs in Sumatra—*S. sumatrana*, Weber; in tropical and South Africa—*S. rousseti*, Kirkpatrick, *S. schubotzi*, Weltner, varieties of *S. sumatrana*, Weber, and *S. bombayensis*, Carter; in the Fiji Islands—*S. gilsoni*, Topsent; and in Eastern China—*S. sinensis*, Annandale. One species—*S. clementis*, Annandale—from the Philippines is doubtfully assigned to the subgenus, and *S. navicella*, Carter, from the River Amazon, appears to be an allied form.

Of the foregoing species the following are most nearly related to *Spongilla benguelensis*, sp. n.:—*S. bombayensis*,

S. indica, *S. graveleyi*, and *S. sumātrana*. All these possess microspined macroscleres, spined microxea, and stronglylous gemmule-spicules. Apart from other characters, all these, except *S. indica*, are clearly marked off from the new species by the possession of oxea as macroscleres. *S. indica*, like *S. benguelensis*, sp. n., possesses stronglylous macroscleres, but is separated from it by various differences in the size and character of the spicules, and particularly by the structure of the gemmules, which in *S. indica* are fixed to the substratum by their outer chitinous membrane and are not enclosed in cages of macroscleres.

A sponge belonging to another genus—namely, *Corvospongilla micramphidiscoides*, Weltner—has a very similar spiculation, but with the addition of free amphidiscs, the possession of which characterizes the genus.

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IX.—On some External Characters of Ruminant Artiodactyla.—Part VII. Domesticated Cattle (*Bos taurus* and *B. indicus*)*. By R. L. POCCOCK, F.R.S.

I. INTRODUCTION.

The question of the origin of domesticated cattle has an extensive literature. The latest volume on the subject known to me was published in 1912 by the late Mr. Lydekker and entitled 'The Ox and its Kindred.' In this the views of previous writers are collated and analyzed, and accepted or rejected as the case may be, the general conclusions arrived at being apparently the following:—

1. Domesticated cattle are descended from two distinct species, one of which (*B. taurus*) is represented in its purest form at the present time by Pembroke, Kerry, West Highland, and British Park breeds, the other (*B. indicus*) by the breeds of zebu or humped cattle of India and elsewhere.
2. The extinct aurochs (*B. primigenius*) was the ancestor of *B. taurus*.
3. The existing banteng (*B. banteng*) was the ancestor of *B. indicus*, a theory originally propounded by Rütimeyer in 1878 and supported by Keller in 1902†.
4. The existence in the southern and some other countries of Europe of cattle partaking of the characters of *B. taurus* and *B. indicus* is due to the introduction of

* The substance of this paper was drafted in 1912 in the form of a review when Mr. Lydekker's volume, 'The Ox and its Kindred,' first came into my hands; but its publication was delayed for a variety of reasons, including my own occupation with other work and my friend's subsequent illness and death. Resumption of work upon the Ruminantia induced me to take up the paper again and cast it in its present form. Although compelled to criticise some inconsistent arguments and theories and dispute a few statements of fact it contains, I must disclaim all intention of disparaging this volume as a whole. It is a valuable compilation, containing in a handy form most of the information about cattle, useful to zoologists and laymen, that could be compressed into the allotted space.

† It is singular that Mr. Lydekker omits all reference to *B. indicus* in his 'Catalogue of Ungulate Mammals,' published in 1913. According to his views this form should have found a place under the subgenus *Bibos*. Perhaps the reason for its omission is that it possesses none of the characters of that group. It may be noted that if the opinion of the descent of *indicus* from *banteng* be true, *indicus* differs not merely specifically, but subgenerically, according to Lydekker, from *taurus*.

the latter into Europe and its subsequent interbreeding with the former.

Proposition 2 may pass as probably true*. Proposition 3 appears to me to be equally probably untrue; while propositions 1 and 4 are open to dispute in the sense that they are founded on facts susceptible of other interpretations.

II. THE BANTENG-DESCENT OF THE ZEBU.

Criticising this theory first of all from the ethnological, and admittedly therefore from a purely theoretical, standpoint, it appears to me improbable that a species domesticated by the Javanese belonging to the Malay stock of the Mongolian race of man was the ancestral form of the cattle of the people of India who belong to a different race. More likely does it seem that the ancestors of modern humped cattle were brought to India by invaders entering the country by way of the Punjab and Sind, unless an autochthonous species, now extinct as a wild animal, was found ready to hand for the purpose in India itself.

There are reasons for believing that the humped cattle have been a domesticated type for a very long time, certainly for a few thousand years B.C. So far as I am aware, there is no evidence, one way or the other, of the antiquity of the banteng as a domesticated animal; but if Rüttimeyer's theory, supported by Keller and Lydekker, that the banteng was the ancestor of the zebu be true, its domestication must be assigned to a much earlier date to account for the acquisition of the distinctive peculiarities of the zebu. Yet, if this be so, it is surely strange that the domesticated banteng of Java and Bali differs in no important points from wild members of the species, still found in Java and Further India. This fact appears to me to be strongly suggestive of the conclusion that the domestication of the banteng has been of comparatively

* This appears to be Prof. Ewart's opinion (P. Z. S. 1911, i. p. 281). In concluding his study of the skulls of Roman cattle obtained at Newstead, he wrote:—"Hence it may be said that up to at least the Bronze Age the majority of the domestic cattle of Europe were the descendants of *Bos primigenius*—some being nearly pure descendants of the imported 'Celtic' shorthorn breed, while others were pure or nearly pure descendants of the indigenous wild urus (*Bos taurus primigenius*)." But since he assumes it to be probable that the "Celtic" shorthorn was itself a domesticated dwarfed descendant of an Asiatic variety of *Bos primigenius*, there is clearly only one wild species involved in the ancestry. The evidence which excludes other breeds of cattle from this genealogy does not appeal to me as at all convincing.

short duration. It may not indeed date back beyond the Dutch occupation of Java in the seventeenth century.

In the second place, the theory seems to me to be inadequately supported on the zoological side. Judging from the banteng I have seen, I should say there is nothing distinctly zebu-like about them except the sloping croup and the sexual dimorphism in colour. Apart from these characters, which I suspect are primitive in the Bovinæ (*cf. infra*, p. 108), banteng exhibit no noticeable resemblances to zebus, except such as are shared by many European cattle above suspicion of zebu blood in their veins. Banteng, indeed, are remarkably "tautine" in style apart from their white stockings, white rumps, elevated withers, and the roughness of the naked skin of the intercornual area in adult bulls. And these characters, be it noted, also differentiate them from zebus, which, in my experience of many individuals of the best-defined breeds, never show a trace of them. This is not what one would expect if the theory of the relationship between the two types were sound. Mr. Lydekker certainly suggests that the white fetlock-rings seen in some zebus may be the remains of the white stockings in the banteng; but whatever be the value of this suggestion, it is discounted in the question at issue by the presence of this ring in some English park cattle claimed to be of pure aurochs descent.

Mr. Lydekker also attempts to explain the hump so characteristic of zebus as the concentrated remains of the tissue covering in the banteng the high spinous processes of the thoracic vertebræ, suggesting that it was left behind, so to speak, when according to the theory these bony processes became reduced during the evolution of the zebu from that species. I do not think this theory of the origin of the hump need be discussed until the supposition upon which it rests, that the vertebræ in question have been shortened, is supported by more evidence than is at present forthcoming. For myself, I should be inclined to compare the hump of the zebu to the accumulation of tissue which may be seen just in front of the withers in many well-fed European bulls (see, for example, pl. xiii. of Mr. Lydekker's volume), and which was quite perceptible in a bull banteng recently exhibited in the Zoological Gardens. However that may be, it cannot in my opinion be seriously claimed that the hump of the zebu and the elevated dorsal crest of the banteng are evidence of affinity between the two. The external appearance of the animals, in short, affords no support to the view that the banteng is the ancestor of the zebu.

It may be recalled that the difference in voice between

B. indicus and *B. taurus* has been frequently advanced as evidence of their specific distinctness. To this I shall refer later (p. 109). If there is any truth in the claim, the argument disposes of the theory of the banteng descent of the zebu. The voice of the zebu I have described below. It differs considerably from that of the banteng, which I have heard described as a roar or bellow. Perhaps Blanford's phraseology applied to the voice of the gaur will convey as good an idea of it as any. He said it is "a prolonged call, not very unlike the lowing of *Bos taurus*, but utterly unlike that of *B. indicus*." Blanford, however, seems to have been unacquainted with the true call of the zebu (*cf. infra*, p. 109). In my opinion, the voice of the zebu differs at least as much from the voice of the banteng as it does from that of *B. taurus*; but for reasons given below I do not think this necessarily disproves the theory of the descent of the zebu from the banteng.

The evidence derived by Rüttimeyer from the form of the skull in the banteng and zebu is rendered, in my opinion, untrustworthy by the extraordinary variability of the skull in domesticated cattle. In any case, the cranial resemblances between the two are not close, as a comparison between Lydekker's figure of the skull of a bull Gujrati zebu (published on pl. xx. of his volume on the Ox) with his figures of the skulls of the Javan and Bornean banteng (published on pp. 24 & 26 of his 'Catalogue of Ungulates' in 1913) will show. The banteng-skulls, indeed, have a relatively longer forehead and shorter face, and thus approximate to the typical taurine type. Nevertheless, the skull is so plastic that I should hesitate to take it as a reliable guide to affinity, one way or the other, where domesticated animals are concerned (*cf. infra*, p. 106).

One other point may be referred to. In both the gaur and the banteng, representing two distinct species of the *Bibos* group of cattle, the urethral canal of the penis ends in a small pointed process, free from the swollen termination of the glans. In the zebu there is no such process, the urethral canal terminating, as in typical *Bos*, on the underside of the swollen end of the glans (Ann. & Mag. Nat. Hist. (9) ii. pp. 451, 454-455, 1918).

III. THE CHARACTERS OF *BOS INDICUS* AND *BOS TAURUS*.

The principal differences between an average Indian zebu and an average British or Spanish fighting bull are well known. The zebu has a hump of fleshy and fatty tissue on

the front of the withers, a more sloping croup, a heavier dewlap, a longer narrower skull with relatively shorter frontal and longer nasal maxillary region; and horns which are more upright in direction of growth. The European animal, on the contrary, has no hump, the plane of the croup is in a line with the back, the dewlap is shallower, the skull shorter but with its frontal portion relatively longer, and the horns are more horizontal in direction of growth. The voices of the two also are different, but not so different as literature would lead one to suppose. Habits and constitution supply further differences.

If there were no other types of domesticated cattle in existence there would be grounds for the opinion of Blyth and others as to the specific distinctness of the two types. But when the differences are analyzed they appear to me to lose much of their weight. Even amongst undoubted Indian zebus there is immense variation in most of the characters mentioned, the hump alone, so far as I am aware, forming an exception. The characters may be considered in order:—

Horns.—Of the horns of the zebu Lydekker (pp. 132–133) wrote:—“The horns of all humped cattle—both Indian and African—differ from those of the aurochs and the related types of European domesticated cattle by their distinctly lyrate shape, the first main curve having the convexity in front instead of behind. Their tendency is also to grow upwards and backwards rather than forwards.” This statement is untrue. In the first place, the horns of Heberstein’s aurochs (pl. iii.) are very like those of the Gujrati zebu (pl. xx.) in direction and curvature. In the second place, the horns of zebus are so variable that it is impossible to affirm anything definite with regard to them. From the type above described by Lydekker from the Gujrati breed the horns may deviate by taking a horizontal direction sideways or a horizontal and forward curvature or a downward inclination. Most curious of all is the type seen in the Mysore breed, where the horns arise close together on the top of the head and recede backwards and upwards, the whole of the anterior surface being concave. In the calf, indeed, they begin as erect buds, not as lateral horizontal buds as in the Gujrati. With regard to the question at issue, the point to be noticed is that the Mysore zebu differs more from the short-horned zebu in the position and curvature of the horns than the short-horned zebu differs from short-horned British cattle. Yet no one supposes these zebus to be other than domesticated breeds of one and the same species.

In European cattle, even setting aside for the moment

those breeds claimed to be of partial zebu descent from the shape of their horns, great variation in these appendages is met with. In any considerable herd of "shorthorns" the horns may be elevated, depressed, or horizontal; and in closely related breeds like the Chartley and Chillingham park cattle the horns differ greatly, being long and downturned in the Chartley and shorter and upturned in the Chillingham (see Lydekker, pl. iv.). Yet in spite of these differences the one breed, I take it, has as much claim as the other to be regarded as a pure-bred representative of *B. taurus*. Apart from the qualification, I entirely agree with Prof. Ewart's dictum (P. Z. S. 1911, pl. i. p. 272):—"Except when they curve forwards at right angles to the frontals, as in typical Celtic shorthorns, the horns assist but little in settling the race to which the Newstead skulls belong." I am not, however, sure whether the term "race" is used in this connection to signify artificially formed "breeds" or natural "species" or "subspecies."

Skull.—As stated above, the skulls of typical zebras differ from the skulls of European cattle of assumed purity of descent from the aurochs in having the frontal region of the skull shorter and the naso-maxillary region longer, coupled with orbits which are less prominent. Although importance has been attached to these points in the attempt to prove specific diversity between the two types, it is surely a matter of common knowledge that, in some domesticated mammals at least, no part of the skeleton is so plastic and subject to such profound variation in structure as the skull. This is well shown in dogs and almost equally well in cattle. One instance only need be cited in support of this statement. Speaking of the Niata or Nata breed of La Plata, Darwin remarked that "on comparison with the skull of a common ox, scarcely a single bone [of the skull] presents the same exact shape, and the whole skull has a wonderfully different appearance." It is needless to mention all the peculiarities described by Darwin and Owen, the most remarkable being the upward curvature of the jaws, the short broad forehead, the extremely abbreviated nasal bones, and the union between the premaxillæ and the lacrymals. These cattle breed true to type, and the interesting thing about them is that the breed must have originated since 1552, when cattle were first introduced into South America. Here, then, we have a clear case of the formation from ordinary European cattle of a type differing from them most profoundly in the structure of the skull. With this proof of the potential variability of the bones of the cranium in European cattle before us, what

justification have we for assuming that the comparatively slight differences between the skulls of European cattle and humped cattle indicate initial specific distinctness between these two? Obviously very little.

The unsatisfactory nature of the evidence supplied by skulls and horns, is attested by the variety of opinions held by authors who have attempted to solve the difficult question of the origins of domesticated breeds of cattle, by relying largely on characters furnished by the cranium and its appendages.

Dewlap.—The dewlap in zebus is often heavier and deeper and sometimes rises nearer the chin* than in European cattle believed to be of unmixed aurochs descent. I cannot satisfy myself as to the precise value attached to this feature by Lydekker. He quotes it as characteristic of zebu, when contrasting them with the European breeds of the aforesaid type, and more than once cites it as evidence of zebu blood in those European breeds that reproduce the character. But a precisely similar difference in the development of the dewlap exists between the domesticated gayal and the wild gaur; yet in this case (pp. 149 & 177) Lydekker uses this difference to support the view that the gayal is nothing but a domesticated race of the gaur, and ascribes the larger size of the dewlap in the former to the effect of domestication, adding "the excessive development of the dewlap in the humped cattle of India is perhaps also the result of domestication." I quite agree with this view, but it clearly disposes of the claim that the larger size of the dewlap in zebus is evidence of their specific distinctness from pure-bred European cattle.

Ears.—Blyth stated that the ears of *B. indicus* differ from those of *B. taurus* in shape, being more pointed. In a general way this is perhaps true; but no zebu that I have seen has ears approaching in apical attenuation those of the Hungarian cow depicted by Lydekker on pl. xv. Even amongst zebus themselves the ears differ so much in size and shape, as may be seen by comparing those of the Gujrati and Mysore breeds (pl. xvii.), that no reliance can be placed on these organs as evidence of specific distinctness between zebus and normal European cattle.

Croup.—Although zebus typically have a sloping croup, and never, within my experience, a horizontal croup like that of European cattle, nevertheless the differences between zebus

* Many of Lydekker's figures illustrating breeds of European cattle show the anterior lobe of the dewlap in the interramal area behind the chin, as in zebus.

in this particular is very great, as is shown by the Mysore and Gujrati breeds represented on pl. xvii. The Gujrati zebu, indeed, has a croup very sensibly approaching that of European cattle in its elevation.

Colour.—One or two colour-characters are mentioned by Lydekker as evidence of specific distinctness between *B. taurus* and *B. indicus*. He speaks of white rings round the eyes and fetlocks as characteristic of the zebu. But since such typical examples of *B. taurus* as park cattle by no means infrequently have white rings round the fetlocks, and since the hair round the eyes in Jerseys, which are beyond suspicion of zebu blood, should, as Lydekker says (p. 115), be cream-coloured or greyish, it is quite clear that no value can be attached to these points. Again, the presence of a light spinal stripe in Kerry cattle (p. 95) in the Craven breed of longhorns (p. 84) and in Castilian bulls (p. 132) is quoted as certain evidence of aurochs descent. Very likely that is the case. But a white spinal stripe is not uncommonly present in pure-bred zebus. Hence if this character has the significance claimed for it by Lydekker, it is evidence of consanguinity between *B. taurus* and *B. indicus*.

Finally, in the tendency exhibited by bull banteng to become black, and thus depart from the rufous tint of cows and young bulls, Lydekker sees the origin of the sexual difference in colour between some breeds of zebu, the cows of which are whitish while the bulls are blackish or iron-grey*. But traditional information about the aurochs suggests that that species also was sexually dimorphic in colour. One aurochs indeed was recorded as grey—presumably, that is to say, zebu-like. Hence the colour-difference between the sexes of zebus cannot be claimed with assurance as a banteng character. So far as it goes, indeed, it suggests closer affinity between the zebus and the aurochs than between the latter and typical breeds of *Bos taurus*, in which the sexes are, I believe, alike. But I am not prepared to lay any great stress upon this point, because, as stated above, I suspect sexual dimorphism of colour in cattle to be a primitive character inherited from a Tragelaphine ancestor†. How-

* Bull calves of the Mysore and Gujrati breeds begin to darken in the first year.

† Lydekker (pp. 32-33 & 253) appears to have been attracted by Prof. Lönnberg's view that cattle are closely related to the gnus (*Connochaetes*). He adds, however, that although the direct ancestry of the ox tribe is still unknown, the earliest representatives of the group are related to the buffaloes, which constitute in some respects the most primitive of

ever that may be, it may be claimed that the coloration of zebus and European cattle affords no support to the view that they belong to distinct species.

Voice.—Blyth and those who have copied him attach great importance to the voice as a criterion of distinct specific origin between *B. indicus* and *B. taurus*. He and Blandford described the voice of the former as a grunt utterly unlike the "lowing" or bellowing of European domesticated cattle. This is only half the truth. Zebus, on the whole, are silent animals, but now and again they utter an abbreviated or prolonged grunt recalling that of a yak or American bison. But they also call with a loud voice which may be perhaps described as somewhat intermediate between the "moo" of an ordinary cow and the hoarse "baa" of a sheep. The sound is distinguishable from that of a cow or bull of British cattle, but I have heard a zebu calf, fretting for its mother, call her with a voice very like that of an English "shorthorn" calf.

The voice is certainly a criterion of kinship in wild animals; but to what extent it is to be trusted in domesticated forms appears to me to be doubtful. It is admitted, I take it, that domesticated fowls are the unmixed descendants of the Bankiva jungle-fowl (*Gallus gallus*). Nevertheless, the crow of the latter is generally, within my experience, distinguishable from that of the former, though unmistakably like it: and different breeds of domesticated fowls often differ to a certain extent in voice, thus attesting the variability, though limited, of this character. Domesticated dogs, too, differ from wolves in having added the bark to the howling voice common to both; yet the wolf or the jackal—it matters not which in the present connection—is usually accepted as the

the living forms and are those whose horns come nearest in shape to those of gnus. This author's reliance on the shapes of horns as tests of affinity led him into few more unintelligible errors than this, excepting only his employment of the curvature of the horns, a manifestly useless character for the purpose, as a basis for the classification of the Bovidae in his 'Catalogue of Ungulates.' With all respect to Prof. Lönnberg, I am quite sure that his opinion about *Comochates* and *Bos* is unsound. The anatomical evidence that gnus are specialized hartebeests (*Bubalis*) and that the cattle are specialized Tragelaphines appears to me to be conclusive. The view that close affinity between the Bovines and Tragelaphines, attested more particularly by the Anoa, the primitive Asiatic buffalo, is quite in keeping with Lydekker's above-quoted statement that the earliest representatives of the ox-tribe are related to the buffaloes, which in some respects are the most primitive of living forms of Bovinae.

wild prototype of the dog. Moreover, pure-bred dingoes and some Eskimo dogs, I am told, never bark. But no one believes them on that account to be specifically distinct from dogs which habitually bark. For these reasons I do not think the differences between the voices of *B. indicus* and *B. taurus* can be held as proof of specific difference between them, and the same concession must be made in the case of the claim of the banteng descent of *B. indicus*.

Habits.—Blyth pointed out that humped cattle in India differ from ordinary European cattle in that they never seek shade and never go into water and stand there knee-deep. Lydekker (p. 150) quotes this passage in his endorsement of Blyth's opinion that the zebu is of different specific descent from European cattle; but his acceptance of the theory that zebu are domesticated forms of the banteng involves the conclusion that an equally great change in habits has taken place, the banteng being a forest-dweller like its ally the gaur. Moreover, when discussing (p. 89) Professor Hughes's denial that British park cattle were derived from an ancestor which dwelt in forests, he admits that the habits of domesticated cattle have varied to some extent from those of their wild ancestors. This admission is founded on the known habit of park cattle of lying out in the open during periods of repose, coupled with the assumption that the aurochs (*B. primigenius*) resembled the gaur in seeking shade. Although the truth of this assumption cannot, in my opinion, be granted, considering that the gaur is a tropical Indian species, whereas the aurochs inhabited temperate latitudes in Europe and Asia, Lydekker's opinion that a change of habit has taken place in park cattle deprives of its value his support of Blyth's claim that the further change in the case of the zebu is evidence of specific difference of origin*.

The zebu's avoidance of water may perhaps be explained, without reference to specific ancestral traits, by its being originally, at all events, a breed raised for survival in hot desert countries where water was periodically scarce, and where in times of drought and shortage of food the hump was useful for the sustenance it supplied. In specimens kept on

* An interesting case attesting variation in habits and instincts of park cattle was reported to me some years ago. The Zoological Society sent a bull and a cow of a mixed Vaynol and Chartley breed to Calcutta. The bull soon died from exposure to the sun, disregarding the shade of a tree in the enclosure. The cow, having the instinct to avail herself of the shelter, survived.

short rations the hump soon begins to dwindle and sag like that of a camel. Prof. Ewart has, I believe, suggested a similar explanation for the accumulations of fat on the rump and tail of some breeds of domesticated sheep.

The constitutional difference between zebus and British cattle, shown by the capacity of the former to withstand the climatic and other conditions even of Brazil and Jamaica, to which British cattle succumb, is precisely what one would expect in the case of two breeds adapted for generations to such widely different physical conditions as are supplied, on the one hand, by tropical India, and, on the other, by temperate Europe.

Blyth maintained that zebus differ from European cattle in their habitual method of carrying the head when at rest. This is quite true of some breeds; Gujrati zebus, for example, hold the head somewhat elevated and not in a line with the spine in the attitude characteristic of *Bos taurus*. The splendid appearance of this breed of zebus, indeed, is due to that circumstance, and, when they are startled, to the alert stag-like lift of the head so different from the slouching carriage observable in other cattle. But Blyth's claim does not apply to all breeds. Mysore zebus, for instance, stand with the head depressed very much as in ordinary cattle. These differences between the two breeds of zebus are well illustrated on pl. xvii. of Lydekker's book, showing a Mysore cow in repose and a Gujrati bull standing at attention.

So far, then, as habits are concerned, there appear to me to be no difficulties in the way of believing in the common origin of *B. taurus* and *B. indicus*.

IV. EUROPEAN AND EGYPTIAN CATTLE OF SUPPOSED ZEBU DESCENT.

Most writers who have written on the subject find evidence of zebu blood in many breeds of cattle of Southern and Central Europe, the character of the horns forming the principal criterion. This claim may be perfectly true, but the testimony produced in its support is by no means convincing. Take, for example, the Transylvanian bull illustrated on pl. i. of Lydekker's book. This beast has the long body, straight back, high croup, long forehead covered with curly hair, short naso-maxillary region in the skull, and short thick legs wrapt up in one's conception of British shorthorns and park bulls. A comparison between the figure

in question and that of the Vaynol bull on pl. v. bears out this contention. The dewlap of the Transylvanian bull is a little deeper, it is true, but it is not appreciably deeper than in the Swiss and Simmenthal bulls, without claim to zebu blood, depicted on pl. xiii. The only striking difference between the Vaynol and the Transylvanian bulls lies in the horns, which in the latter are much longer and extend at first horizontally outwards and then upwards; but they are not like the horns of any Indian zebu I have seen, and differ no more, perhaps less, from the upturned horns of the Chillingham breed than the latter differ from the downturned horns of the Chartley breed shown on pl. iv. Hence it appears to me that the evidence of zebu blood in the Transylvanian bull is quite untrustworthy; and if the head of this animal be compared with the skull of the Spanish draught ox (pl. xiv.), another breed of assumed zebu descent, it will be evident that, so far as the head and horns are concerned, the two breeds are very much alike. The assumption that the Spanish draught cattle are wholly or partly zebus, in which the hump has been eliminated by selective breeding or crossing, seems to me inadequately supported by the facts.

The same theory has been put forward to explain the zebu descent of some of the humpless cattle of ancient Egypt, and to illustrate the characters of these cattle Lydekker reproduces two figures from Egyptian monuments—one (p. 135) showing four cows, the other a bull (pl. xvi.),—which in general style resemble the Transylvanian bull aforesaid, and are believed by Dürst and Lydekker to belong to the same stock and to have been introduced into Spain. That the Egyptian cattle belong to the same stock as the Spanish may be admitted, on the evidence, as probable, and that they were introduced into Spain as possible; but since they have the long bodies, humpless withers, high croup, and shallow dewlap of typical examples of *Bos taurus*, the claim that they are zebus with the hump artificially suppressed is surely unwarranted. At all events, the identification of these cattle must be admitted to be a matter of doubt. If they are not zebus, as I maintain, what becomes of the theory that their supposed introduction into Spain by the Moors or other invaders supplies the explanation of the alleged zebu blood in Spanish draught cattle?

I find similar difficulties in agreeing with Lydekker's determination of the Nineveh bull, depicted on p. 64, which he says appears to be an aurochs despite the absence of the mane and the excessive length of the tail. The animal,

however, has a collar on the neck suspiciously suggestive of domestication. It may be noticed, too, that the elevated carriage of the head recalls that of the Gujrati zebu shown on pl. xvii. Lydekker also remarks,* in connection with this supposed aurochs, that it is "quite unlike the figure of the ancient Assyrian humped ox" reproduced on p. 140 of his book. Of these he wrote:—"In the contour of the neck and shoulders, as well as in the direction of the horns, the representations of these humped cattle differ widely from those apparently representing the aurochs (p. 64). That these long-horned cattle did not come from Egypt is demonstrated by the presence of the well-developed hump, but the horns are of the Egyptian type."

I cannot in any way reconcile these statements with the facts. The figure shows a pair of heavily built, short-bodied, long-legged oxen, with high carriage of the head. The animal in the foreground is polled, and has a very poorly, not a well-developed hump. It might pass for a polled zebu with an incipient hump, although the dewlap is absent, instead of being well grown as it is in that breed. The animal in the background, mostly hidden by its companion, has stout horns of medium length, which, instead of resembling, as alleged, those of the Egyptian cattle in their upward trend, are turned horizontally forwards in a line with the back, the point only being hooked upwards, almost exactly as in the figure of the Augsburg aurochs (pl. iii.). These horns appear to me to differ in no important respect from those of the supposed Assyrian aurochs, except that they are a little longer. The hump is not shown in the illustration; hence, if present, it was not larger than that of the ox in the foreground. Granting the presence of a small hump, it may be maintained that in that particular only does the horned bull of the pair in question, believed to be a zebu, differ from the above-quoted Nineveh bull, believed to be an aurochs.

If Lydekker's identification of these two Assyrian bulls be correct, it seems to me that the conclusion derived therefrom is precisely the opposite of that which he maintains, in the sense that the case supplies very strong evidence of the aurochs descent of the zebu. But apart from allowing that these Assyrian sculptures furnish interesting evidence of the existence of domesticated cattle approaching the zebu-type in many particulars in Mesopotamia at an early historic period, I do not think very great reliance should be placed upon structural details in mouldings apparently largely conventional. My purpose in referring to these and other cases

discussed in this section, is to show that the diversity of interpretation of which they are susceptible weakens the force of the contention that European breeds of cattle are of dual specific origin.

V. CONCLUSIONS.

1. Indian humped cattle (*Bos indicus*) are not descended from the banteng (*Bibos banteng*), but from some species of *Bos*, to which genus, or subgenus, they belong.
2. They intergrade in almost all characters with *Bos taurus*. Such differences as typical representatives of the two breeds exhibit are quite compatible with the view of their descent from a common ancestor, probably the aurochs (*B. primigenius*); but zebus may be the descendants of a form of *Bos* differing subspecifically, perhaps specifically, from *B. primigenius*, but closely related thereto. Nevertheless, if that be so, the extreme differences between *B. taurus* and *B. indicus* are not traceable to original ancestral differences, but are the product of long-enduring domestication, under widely distinct physical conditions, coupled with selective breeding along divergent lines guided by different tastes and needs*.
3. The claim that some European cattle have an admixture, small or great, of zebu blood, due to the human introduction of that stock into Southern Europe is not established by the facts adduced in its support. It may, however, be true. On the other hand, the alleged zebu characters of such cattle may be explained, if the allegation be sound, by their representing stages in the evolution of the zebu type from *Bos primigenius*.

* * Although the conclusion that *B. taurus* and *B. indicus* had a common ancestor or are possibly the descendants of two closely allied forms of *Bos* has been reached by the analysis of a different class of facts, it seems to coincide with that of several modern students of the group. Prof. Ewart, for example (P. Z. S. 1911, pt. ii. p. 281, footnote), thinks it probable that the long-browed short-horned zebus are probably representatives of the small domesticated ox of Anau, the so-called Celtic shorthorn, itself of aurochs descent. Perhaps the settlement of the disputed relationship between *Bos namadicus*, the so-called Asiatic aurochs, and *Bos primigenius*, the European aurochs, which was apparently also of Asiatic origin, may supply an answer to the still doubtful question as to whether the domesticated cattle discussed in this paper trace their descent from two distinct species of *Bos* or from two local races of a single species.

X.—On some small Mammals from Catamarca.
By OLDFIELD THOMAS.

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THE British Museum has received a small collection of admirably prepared skins of mammals, mostly rodents, obtained at Chumbicha, Catamarca, by Sr. E. Budin, and a list of these seems desirable.

Chumbicha is about 60 kilometres due south-west of the town of Catamarca, and lies at an altitude of about 600 metres.

The collection consists of eighty-nine specimens, belonging to nine species, of which one has already been, and two are now, described as new.

1. *Eligmodontia marica*, Thos.

Ann. & Mag. Nat. Hist. (9) ii. p. 483 (1918).

♂. 299, 311; ♀. 296, 312. Eastern, desert, side of Chumbicha.

Notes about this beautiful little species have already been published (*l. c.*). Its type is no. 311. B.M. no. 18. 11. 11. 1.

It is readily distinguishable by its small size and snowy-white belly.

The four specimens were all caught in one place in the desert area to the east of Chumbicha, and none were seen elsewhere.

2. *Hesperomys murillus cordovensis*, Thos.

♂. 231, 251, 292, 298, 300, 302, 306, 307, 313; ♀. 297, 301, 303, 304, 305, 308, 309, 310.

"Caught among the wild cactus-plants.—E. B."

The type-locality of *cordovensis* is Yacanto, near Villa Dolores, Cordova, some 250 kilometres south-east of Chumbicha.

3. *Gracorys* sp.

♂. 226, 232, 233, 236, 237, 245, 254, 260, 262, 263, 274, 275, 278, 281, 285, 288, 291, 293, 294, 314; ♀. 223, 244, 250, 261, 264, 279, 282, 284, 295, 315.

This fine series will be of much service when time and material are available for a thorough study of this difficult genus. Among these specimens there are examples with the belly-hairs white to the roots, and others with slaty-based

ventral hairs, but how far this is in part a character of age remains to be seen.

The present form seems most nearly allied to *G. chacoensis* and *lockwoodi*, but for the moment I prefer not to venture a definite determination of it. Its teeth and bullae are larger than in the geographically adjacent *G. centralis*.

4. *Phyllotis* sp.

♂. 224, 227, 234, 235, 239, 240, 246, 249, 258, 269, 271, 272, 283, 286, 287, 290; ♂. 238, 243, 255, 270, 276, 277.

Apparently not distinguishable from *Ph. wolfssohni*, Thos., but the members of the *darwini* group are all so closely allied that without a special study of them a definite determination is not easy to arrive at.

The presence of divergent supraorbital edges in the type of *Ph. wolfssohni*, as described in the original account, appears to be abnormal, or due to great age, as specimens since received are like *Ph. darwini* in this respect. Well-developed supraorbital ridges are characteristic of *Graomys*.

As in other places the *Phyllotis* and *Graomys* live side by side, and are by no means always easy to distinguish from one another at first sight. The latter, however, has a longer and more hairy tail, and its belly-hairs, whether grey at base or not, have always definitely white tips, while those of the *Phyllotis* are more or less drabby or brownish.

5. *Oryzomys flavescens*, Waterh.

♀. 241.

Rather larger than Uruguay examples.

6. *Akodon glaucinus*, sp. n.

♂. 222, 225, 242, 259, 266, 268, 280; ♀. 229, 230, 267.

Externally closely similar to the Tucuman *A. simulator*, but the general colour is paler and less "saturate," the buffy or clay-colour of the dorsal area is less intense and is absent or scarcely perceptible on the crown, while the shoulders and the area behind the ears are distinctly more bluish grey. The white patch on the chin is constantly present, as is also probably the case in *A. varius*, but, owing to the condition of the skins of the latter, it was not originally perceived.

Skull apparently similar in shape to that of *simulator*. Supraorbital edges, even of the oldest specimen, not very sharp. Set of incisors of the normal orthodont nature, not proodont as in *A. lactens*.

Dimensions of the type (measured in flesh):—

Head and body 98 mm.; tail 75; hind foot 22; ear 18.

Skull: greatest length 27.5; condylo-incisive length 26; zygomatic breadth 14.3; nasals 10; interorbital breadth 5; breadth of brain-case 12; palatilar length 12.2; palatal foramina 7; postforaminal palate 4; upper molar series 4.8.

A single very old male, no. 225, is decidedly larger, the head and body 115 and the skull 30.5 mm. in length.

Hab. as above.

Type. Adult male. B.M. no. 18. 11. 11. 57.* Original number 222. Collected 24th June, 1918.

"Caught under rocks among roots of trees."—*E. B.*

While there is no doubt that *A. varius*, *A. simulator*, and the present form are so closely allied that they may hereafter be shown to represent subspecies of one widely-spread species, I provisionally give a binomial name to this animal until such time as fuller material shows the true relationship between the different members of the group.

7. *Akodon arenicola*, Waterh.

♀. 228.

8. *Ctenomys fochi*, sp. n.

♂. 247; ♀. 248, 256, 265.

■ Closely allied to *C. bergi*, Thos., of Cruz del Eje, Cordova, with which it agrees in size. General colour, however, more drabby, the tone near "buffy brown" of Ridgway, while that of *bergi* is more like "saya brown." Hairs of under surface washed with paler drabby, the hairs everywhere slaty at base, while those of the interramia are in *bergi* buffy to their roots. Dark area on muzzle and crown nearly black, much darker than in *bergi*.

Skull like that of *C. bergi*, except that the bullæ are uniformly (four specimens as compared with three) rather more inflated, the line connecting the antero-internal angle with the meatal tube more distinctly convex forwards, as viewed from above.

Dimensions of the type:—

Head and body 162 mm.; tail 76; hind foot 30.

Skull: greatest diagonal length 39; condylo-incisive length 37; zygomatic breadth 23; nasals 11.2 × 5.2 (in another specimen 12.5 × 5.7); least breadth across brain-case 17; meatal breadth 24.5; bulla, greatest diagonal diameter 15.2, breadth at right angles to last (exclusive of meatal tube) 8.5; upper molar series (crowns) 8; alveoli 8.8.

Type. Young adult male. B.M. no. 18. 11. 11. 68. Original number 247. Collected 2nd July, 1918.

This species is clearly most closely allied to *C. bergi*, but is distinguished by the characters above described. From *C. tucumanus*, its next neighbour northwards, as also from *C. mendocinus* to the south, it is readily separated by its much smaller size and the darkened upper surface of the muzzle.

"Lives in very dry red earth."—*E. B.*

Named in honour of Gen. Foch, by whose genius victory in the recent great struggle has been so greatly accelerated.

9. *Marmosa elegans pallidior*, Thos.

♂. 253, 257, 273; ♀. 289.

The white middle area of the belly is quite as in the "Acochayas" of Bolivia and of Umahuaca, Jujuy, those of Tucuman and Leon, Jujuy (*M. e. cinderella*) having slaty-grey bases to the ventral hairs.

"Caught among the rocks."—*E. B.*

XI.—*Descriptions and Records of Bees.*—LXXXIII.

By T. D. A. COCKERELL, University of Colorado.

Proteraner rhois, Cockerell.

Male, Meadow Valley, Mexico (*Townsend*).

New to Mexico.

Sphecodes mexicanorum, sp. n.

♀.—Length about 8.5 mm.

Black, with the abdomen red, the first segment with a large black area occupying the base and extending more than halfway to apex in middle, the third and fourth segments with a black stain in middle, the fifth and apical segments black. Head and thorax with dull white hair; mandibles dark reddish apically, with a blunt inner tooth far from apex; labrum short, simple, transversely sulcate; antennæ entirely dark; clypeus strongly punctured; front finely and densely punctured; mesothorax and scutellum strongly punctured, but shining, the punctures quite widely separated on disk; area of metathorax shining, with about twelve strong longitudinal plicæ; posterior face of metathorax very coarsely

punctured; tegulae rufo-fuscous. Wings dusky, stigma and nervures dark brown. Legs very dark reddish brown; spurs ferruginous. Abdomen not appreciably constricted between first and second segments; first segment impunctate, the following with extremely fine punctures in the basal region; apical segments with hoary pubescence.

Meadow Valley, Mexico (C. H. T. Townsend). U.S. Nat. Museum.

In my table in Ann. & Mag. Nat. Hist., Nov. 1907, this runs to *S. dichrous*, Smith, from which it is readily known by the impunctate first abdominal segment and other characters. On account of the thin hoary pubescence on apical part of abdomen it recalls *S. pilosulus*, Smith, from Oaxaca, but that has the thorax closely punctured.

Melissodes albocincta, sp. n.

♀.—Length about 10 mm.

Compact, black; antennae beyond the fourth joint ferruginous beneath; eyes pale grey; small joints of tarsi reddish; tegulae piceous, posteriorly paler and reddish. Wings faintly dusky, nervures and stigma dark brown; hind margins of abdominal segments (first narrowly, second broadly) colourless; pubescence greyish white, pale on vertex, but disk of scutellum with fuscous hair. Hair on outer side of tibiae and tarsi suffused with reddish, on inner side of hind basitarsi bright ferruginous; hind tibial scopa long, loose, and strongly plumose; hind margins of abdominal segments 2 to 4 with broad felt-like entire white hair-bands; black parts of first three segments exposed and shining, hardly punctured, but that of fourth covered with very short fuscous hair; fifth segment covered with dark chocolate hair, paler at margin, creamy-white at extreme sides; pygidial plate narrow; mesothorax and scutellum highly polished and sparsely punctured, the mesothorax with a shallow median longitudinal groove.

Mexico (Baker collection, 2320). U.S. Nat. Museum.

This may be referable to *Xenoglossodes*; I have not ventured to extract the mouth-parts of the unique type. It certainly closely resembles *X. excurrens*, Ckll., differing principally by the white hind margins of abdominal segments. In my table of *Melissodes* (1906) it runs next to *M. martini*, Ckll., which it does not resemble.

Ptilothrix heterochroa, sp. n.

♀ (type).—Length about 10.5 mm.; anterior wing 7.7 mm. Black, with black and greyish-white hair; hair at sides of

abdominal segments 2 to 4 strongly washed with orange, which extends some distance along the bands on 3 and 4; fifth segment with dark fuscous hair in middle and orange at sides; flagellum obscure reddish beneath; mandibles chestnut-red in middle; clypeus prominent, bare, highly polished, with sparse distinct punctures; front and sides of face with white hair, but vertex with black; face broad; tegulæ rufo-piceous. Wings reddish. Hair of upper part of thorax greyish white, but a fuscous band across mesothorax and another across scutellum; lower half of mesopleura with dark chocolate hair; mesothorax highly polished, with sparse punctures. Legs dark reddish, their hair black; hind spurs curved at end.

Very close to *P. tricolor* (Friese), but much smaller, with narrower abdomen, more sparsely punctured disk of mesothorax, and smoother, more polished basal area of metathorax.

♂.—Antennæ hardly reddened beneath; face and lower part of cheeks with white hair, but the black hair of vertex also invades upper part of front; clypeus finely and rather closely punctured; thorax above with black hair, the margins of the mesothorax (broadly in front) with greyish white; pleura with black hair, but a tuft of greyish white just below tegulæ; thorax posteriorly with black hair; small joints of tarsi red; abdomen with black hair; a cuneiform orange patch at each side of third and fourth segments, a little of the same at sides of fifth; greyish-white hair at sides of first and second, and disks of these segments with very thin greyish-white hair, but hair on base of first segment black.

Cucarana, Argentina (*L. Bruner*). U.S. Nat. Museum.

The female (81) is the type; the male (56) seems to be correctly associated, but it differs much in appearance and may possibly belong to a different species.

Diadasia separata (Holmberg).

Cucarana, Argentina (*Bruner*, male 42, female 68).

This is *Teleutemnesta separata*, Holmberg. Holmberg described only the female; the male is similar, but the flagellum is only faintly reddish beneath, and there is no red hair at end of abdomen. The hind basitarsi are slender and curved.

Ceratina nautlana, Cockerell.

Vera Cruz, Mexico, Dec. 14, 1907 (*F. Knab*).

The wings are browner than usual.

Heriades sauteri philippinensis (Friese).

Philippine Islands; the type from Los Banos. A female from Manila (*Robert Brown*) is in U.S. Nat. Museum.

This differs from *H. sauteri* in the more finely punctured mesothorax and first abdominal segment.

Trigona itama, Cockerell.

Described from Singapore, but I cannot distinguish a specimen from Pelaboean Ratoe, Java (*Bryant & Palmer*), in U.S. Nat. Museum.

The black tegulae distinguish it from *T. iridipennis*, Smith, which seems to be the common species in Java. The wings are fuliginous.

Nomia bantarica, sp. n.

♂.—Length nearly 8 mm.; anterior wing 6.7 mm.

Head black, with the clypeus (except sides above) and region of mouth ferruginous; mandibles very pale basally, dark chestnut-red apically; face densely covered with golden pile; vertex polished and shining; scape clear ferruginous; flagellum black above and red beneath; thorax black, with the tubercles, scutellum, and postscutellum clear red; upper border of prothorax densely covered with cream-coloured tomentum; mesothorax bare, dullish, the sculpture extremely fine; scutellum convex, not at all bigibbous; metathorax highly polished; tegulae testaceous. Wings dusky, nervures and the large stigma dusky reddish; second s.m. small, third long. Legs clear light ferruginous, with concolorous hair; hind legs simple, but the femora and tibiae rather stout. Abdomen smooth and shining, without hair-bands, ferruginous, with a large black patch on each side of second segment, third and fourth segments with very broad black bands. The tegulae are not enlarged.

Bantar, Gebang, Java (*Bryant & Palmer*). U.S. Nat. Museum.

By its coloration it recalls *N. griseodol*, Vachal, from Borneo, but that has the abdomen eight-spotted and the scutellum bigibbous.

Halictus laeviventris, Pérez.

Tokyo, Japan (*Sasaki*, 149).

Pérez says this is of the size of *H. fallax*, which would be 7.5–8 mm., but he says that *H. discrepans*, 8 mm. long, is smaller than *laeviventris*. The specimens of *laeviventris*

before me are about 9 mm. long, anterior wing 7.5 mm. The first abdominal segment is highly polished and impunctate. The insect is in all respects closely allied to *H. seznotatus*, Kirby.

Halictus occidentis, Smith.

Kiso-fukushima, Japan, July 27, 1914 (*Sasaki*, 174).

The lateral borders of posterior face of metathorax are sharply margined. The hind spur has broad, rounded, nodule-like teeth.

Halictus tsushimensis, n. n.

Halictus orientalis, Pérez, 1905 (not of Lepeletier, 1841).

Tsushima, Japan.

Allied to *H. occidentis*, but with more punctured abdomen and very smoky wings.

Halictus basicirus, sp. n.

♀.—Length about 8 mm.; anterior wing about 6.5 mm.

Black, including the legs and hind margins of abdominal segments; head longer than broad, but not oval; mandibles reddened at apex; head and thorax with abundant pale ochreous hair, that on postscutellum light ferruginous; clypeus shining and well punctured; mesothorax very densely punctured, but shining between the punctures; area of metathorax semilunar, rather short, with fine, regular, but rather wavy longitudinal plicæ; posterior truncation very hairy, not conspicuously defined; tegulæ piceous. Wings hyaline, stigma and nervures amber-colour. Legs with pale ochreous hair, a line of fuscous on outer side of hind tibiæ; hind spur very minutely nodulose, appearing simple under a lens. First abdominal segment polished and shining, minutely punctured all over, the base broadly and densely covered with long pale ochreous hair; remaining segments also shining and punctured, the bases of segments 2 to 4 with entire bands of ochreous-tinted tomentum; caudal rima fringed with pale ochreous hair.

Japan, marked 167 and 358, but what these numbers signify I do not know. U.S. Nat. Museum.

In the Japanese fauna it seems nearest to *A. japonicola*, Strand, but it is larger and does not show the microscopic sculpture between the punctures on mesothorax and first abdominal segment. It is very close to *H. perangulatus*, Oki!, from Formosa, but the posterior part of mesothorax is much more closely punctured.

Halictus japonicus, Dalla Torre.

Smith described the male under the preoccupied name *H. tarsatus*. I found the female in the British Museum collection, and, as Vachal himself suggested, it appears to be the same as *H. tæniolellus*, Vachal, which may be safely regarded as a synonym.

Halictus subopacus, Smith.

Soochow, China (*N. Gist Gee*, 118, 119).

Another species of the type of *H. basicirrus*, from which it is known by the dullish and closely punctured first abdominal segment.

Halictus poonaënsis, n. n.

Halictus torridus, Cameron, 1898 (not Smith, 1870).

Poona, India.

Halictus nusaënsis, Friese, in litt., 1914.

Halictus nigroviridis, Friese, 1914 (not Graenicher)

Java.

Halictus bryanti, sp. n.

♀.—Length about 8 mm.; anterior wing 6 mm.

Black, robust, with unusually broad abdomen, the sides of which are parallel except at the ends; hair of head and thorax scanty, dull white, the postscutellum with white tomentum; head ordinary; mandibles only faintly reddish at apex; face thinly covered with pale hair; clypeus with weak shallow punctures, the subapical middle depressed; front dull, vertex shining; flagellum very faintly brownish beneath; mesothorax shining but not highly polished (the surface being microscopically tessellate), with small sparse punctures; scutellum more polished, slightly bigibbous; mesopleura almost entirely opaque; area of metathorax short, with very distinct plicæ on its basal part; posterior truncation shining, impunctate, sharply margined at sides; tegulæ black, dark reddish in middle. Wings dusky; nervures and stigma dark fuscous. Legs black, with pale hair, fuscous bands on outer side of middle and hind tibiæ; hind spur with three very large obtuse spines. Abdomen shining, but the surface minutely lineolate, and with excessively minute punctures scattered all over; bases of segments with dull white hair, conspicuous and dense at sides of second; hind margins black; segments 3 and 4 with rather obscure subapical hair-bands.

Buitenzorg, Java, March 1909 (*Bryant & Palmer*). U.S. Nat. Museum.

In Friese's table of Java *Halictus* (1914) this runs nearest to *H. thoracicus*, Friese, which Messrs. Bryant & Palmer also took at Buitenzorg, but the sculpture of the thorax is entirely different.

Halictus palmeri, sp. n.

♂.—Length about 5.5 mm.; anterior wing 5 mm.

Black, rather robust for a male; head and thorax with very scanty dull white hair; head ordinary; clypeus produced, wholly black, shining, with sparse punctures; front slightly shining, with fine punctures; flagellum very faintly brownish; mesothorax and scutellum very highly polished, with only microscopical sparse punctures; area of metathorax rather long, with very fine anastomosing plicæ, appearing dull and granular under a lens; tegulæ dark reddish. Wings dusky; stigma and nervures dark reddish. Legs black, tarsi reddish apically. Abdomen shining, impunctate, with thin pale hair on apical part, small patches of white hair at lateral bases of second and third segments.

Tjibodas, Mt. Gede, Java, alt. 4500 ft., Oct. 9, 1909 (*Bryant & Palmer*). U.S. Nat. Museum.

*Distinct from the species previously described from Java by the highly polished mesothorax, without evident punctures.

Halictus gedensis, sp. n.

♀.—Length about 6.5 mm.; anterior wing 6 mm.

Black, the head and thorax with scanty dull white hair; head ordinary, rather broad; mandibles black; clypeus shining, sparsely punctured, it and the supraclypeal area distinctly longitudinally ridged in middle; front dull; flagellum very obscurely reddish beneath; mesothorax shining, but not highly polished, with small shallow punctures, and the surface microscopically tessellate between; scutellum with a median sulcus; postscutellum with long hair; area of metathorax poorly defined, with irregular plicæ on basal part; posterior truncation small; tegulæ reddish black. Wings dusky, long and ample; stigma and nervures dark brown. Legs black, with pale hair; hind spur white, with seven short spines. Abdomen shining, impunctate, without hair-bands; apical part and general surface more or less with pale hair, abundant on fifth segment.

Tjibodas, Mt. Gede, Java, alt. 5000 ft. (*Bryant & Palmer*). U.S. Nat. Museum.

Runs in Friese's table to the much larger *H. jacobsoni*, Friese.

Halictus erythrurus, Cockerell.

♀.—York, W. Australia (*O. H. Sargent*).

The specimen has two large black marks on the fifth abdominal segment, sublateral and lateral spots on the fourth, and lateral spots on the third. I have a specimen from the type-locality with lateral spots on the abdomen, so the peculiarity can hardly indicate a subspecies.

Halictus melanurus, sp. n.

♀.—Length about 4 mm.

Black, with the abdomen about as far as middle of third segment shining yellowish-ferruginous, beyond that very dark fuscous, almost black, basal half of first segment also dusky; labrum and mandibles except apex dark red; flagellum clear ferruginous beneath except at base; tegulae clear ferruginous. Legs dusky red, with the anterior tibiae in front and all the knees clear red; pubescence scanty, dull white. Abdomen without hair-bands. Wings clear, stigma and nervures ferruginous; outer r. n. and t. c. much weakened; first r. n. meeting second t. c. Head ordinary, face broad; clypeus shining; front dull; mesothorax moderately shining, very finely punctured; area of metathorax rough, with delicate plicae, the margin shining. Microscopical characters:—Front densely punctured, the surface between the punctures finely sculptured; mesothorax microscopically tessellate, anteriorly transversely lineolate; area of metathorax with wrinkled plicae; hind spur of the simple type (microscopically serrulate or spinulose). *

York, W. Australia (*O. H. Sargent*). U.S. Nat. Museum.

Related to the Tasmanian *H. disclusus*, Ckll., but easily separated by the red tegulae. It is also a smaller species. The scopa on hind tibiae is rather short and thin, but beautifully plumose.

XII.—Notes from the Gatty Marine Laboratory, St. Andrews.—No. XLII. By Prof. M'INTOSH, M.D., LL.D., D.Sc., F.R.S., &c.

1. Preliminary Studies on *Filograna*: a, Historical; b, Faunistic; c, Structural; d, General.
2. On *Harmothoe watsoni*, M'I., and var. *H. marphysæ*, M'I.

1. Preliminary Studies on *Filograna*.

(a) HISTORICAL.

Filograna, the subject of the following remarks, has probably been known to marine zoologists from very early

times, though a definite name was not assigned to it. Amongst others, Seba* (1758), in alluding to various marine "mosses, corallines," and tubular corallines, *Congerius minutorum tubulorum*, which he figures in his 'Thesaurus,' specially refers to this form, which he found adherent to rocks and other structures, in one instance forming the basis to which *Thuiaria thuja* was attached (fig. 19 a). He figures correctly the spaces between the fascicles of tubes forming the mass. Though Plancus *De conchis minus notis* is quoted by some authors in this connection, nothing definite can be found in his work. Linnæus, Risso, Pallas, and others placed it under the genus *Serpula*, whilst a few included it under *Protula*. Oken termed it *Clymene filograna*; Ray, *Reticulatum trophaceum*; Boece, *Tubularia filograna*. The form is interesting in some other respects than zoologically, since it occasionally blocks the pipes leading from the sea to the Marine Laboratory tanks, as at Port Erin †.

Berkeley (1827) clearly described the form with the opercula, which he dredged at Weymouth. In the 'Zoological Journal, Volume of Supplementary Plates' (and not in vol. iii.) he gives a figure (pl. xviii. fig. 3) in which a somewhat pointed, hollow operculum is on each dorsal branchial filament. He shows seven pairs of thoracic bristles, and in the posterior (so-called abdominal) region is an indication of a twist, or it may be a bud.

Filograna implexa, as described by Sars ‡ (1846) in his first part of the 'Fauna Littorales Norvegiæ,' had six pairs of thoracic bristles in addition to the collar-bristles, two opercula on the dorsal branchiæ (right and left fans), and two eyes. He gave no minute description of the "vermiform" and figured only a few of its tubes.

Oscar Schmidt § (1848) alluded to *Filograna implexa*, and stated that he had found a new species at Faroë with buds at all stages. The same year he || described *Filograna schleideni* from the Faeroës, which he, as indicated, believed to be a new species, characterized by the absence of opercula and the arrangement of the eyes, which formed a row of four on each side of the middle line. He shows seven pairs of bristled feet in the anterior region, but does not differentiate the collar-bristles or figure them, unless he intends the first

* 'Catalogue of the Curiosities in the Cabinet of Albertus Seba.

† I have to thank Mr. Chadwick for this information.

‡ Fauna Litt. Norveg. i. p. 86, Tab. 10, figs. 12-19.

§ Forieps Notizen, No. 183, p. 162, August.

|| Neue Beitr. Naturgesch. Würmer, Jena, p. 33, Taf. iii. fig. 7.

of the series, which follows the same backward slope as the others, to represent them, though this is unlikely. He describes and figures a bud, and compares it with budding in the Turbellarians and Naidæ. On the whole, there are no reliable grounds for separating this form from *F. implexa*.

Dalyell* (1853) gave a graphic account of the external features of the annelid and its mass of tubes, which, he correctly stated, was "penetrated by numerous deep cavities of indeterminable size and form." He also found the greyish annelids of unequal size, but he did not notice buds.

Huxley † in 1855 furnished a careful account of the southern type which he termed *Protula dysteri*, its distinguishing features being its "fissiparous multiplication" and its hermaphrodite condition. He described the branchiæ and their green blood-vessels; the alimentary canal with its crop, stomach, and intestine; the "vascular" system, which he did not consider equivalent to that of higher forms, the cœlomic fluid representing it; the nervous system, reproductive elements, setæ, and uncini; and concluded by a digest on fissiparous multiplication. He describes a ciliated canal running along the ventral surface of the intestine and apparently opening at the anus, but such probably was a misapprehension. He did not discriminate the differences in the structure and distribution of the bristles, yet the general account is worthy of the distinguished author, who, however, considered in 1865 that his form was probably identical with the northern type which had previously been described by Sars.

Keferstein ‡ (1862) found the same form at St. Vaast with free-swimming young. His figures of the bristle and hooks are insufficient for identification, though they apply to the common form.

Claparède § in 1863 procured *Protula dysteri* off the shores of France, and gave a detailed description of it. He likens the expanded branchial apparatus of the annelid to the lophophore of a Polyzoon. His examples had two eyes and occasionally other black specks. In the main his account agrees with that of Huxley, though he points out and figures the enlargements at the tips of the branchial filaments not mentioned by the English author. These enlargements,

* Powers Creat. ii. p. 250, pl. xxxiv. figs. 1-6.

† Edin. New Philos. Jour. vol. i. n. s. p. 113, pl. i. figs. 1-11.

‡ Zitsch. f. w. Zool. Bd. xii. p. 128, pl. xi. figs. 23 & 24 (1862).

§ Beobach. Anat. u. Entwicklungs. Wob. Thiere, p. 31, Taf. xv. figs. 16-22.

which he describes as leaf-like, are as conspicuous as in *S. edificatrix*, but his representation of them (pl. xv. fig. 17) would convey an erroneous impression as to their structure and relationship to the filaments. He did not discriminate, however, the minute structure of the collar-bristles of the anterior region, and his description and figure of the hooks is also different from Nature, for he appears to have counted the serrations of each hook as a separate organ—at any rate, his figure diverges from Nature. The first segment of the posterior region (his abdomen) he describes as devoid of bristles. He did not notice the two anal papillæ. The male elements (ripe sperms) he placed in the thirteenth segment, and the female in the following seven to eleven segments. In his description of the buds he alludes to the early condition of the branchiæ, but with the exception of a figure of the early stage he adds little to what Huxley had previously recorded.

Claparède (1873) thought that Huxley exaggerated the views of De Quatrefages in regard to the blood-system of the Annelids. He considered a pseud-hæmal-system quite different from that of the superior animals, and resembling the vasculariform excretory system of the Rotifera, Cestodes, and Trematodes. He disagreed with this, for both morphologically and physiologically the blood-system is connected with assimilation.

De Quatrefages* describes the genus as having two false opercula, whilst his species *Filograna berkeleyi* and *F. implexa* do not appear to differ, for the coalescent uncini of the former and the angular teeth of the latter need not be seriously considered, since his figures of bristle and hook are not sufficiently accurate. His third form, *Filograna dysteri* is Huxley's species, and his fourth is the *F. schleideni* of Schmidt†, a variety of the common form. De Quatrefages overlooked the distinctive characters of the collar-bristles.

The genus *Salmacina*‡ was established by Claparède§ in 1868 for Serpulids having a thoracic membrane, regular branchiæ with a circular base, devoid of an operculum, the first thoracic segment furnished with tufts of distinctive and much larger bristles than those which follow, and dwelling in calcareous tubes. While it agrees with *Protula* in the absence of an operculum, it differs in the larger collar-

* Annales, ii. p. 435, pl. xv. figs. 9-12 (1865).

† Neue Beiträge Naturges. der Wurm. p. 33, pl. 3.

‡ Named after the hermaphrodite nymph *Salmacia*, a name already employed by L. Agassiz in the Echinida.

§ Annel. Chétop. Naples, p. 436.

bristles of the first thoracic segment. He was fully aware of its approach to the Serpulaids and *Filograna*, yet the absence of an operculum separates it from both, though here can be no question of its close affinity with *Filograna*, the more so as *Salmacina* reproduces by posterior buds. He thought that *Protula dysteri*, which De Quatrefages united with *Filograna*, should probably be embraced in his genus, though the enlargements at the tips of the branchial filaments do not merit the name of opercula. He mentions, further, that it would be as reasonable to include the eyes at the tips of the branchiæ in *Branchiomma* as opercular as such swellings in *Protula dysteri*.

His first species was *S. incrustans**, which he thought might be synonymous with *Serpula incrustans* (Linn.), Grube †, and *Serpula filograna* of Sacchi ‡. In his specific characters, however, no distinctive feature of moment is recognizable, for in length (2 to 2.5 mm.), colour, the number of the thoracic segments (8), the three kinds of dorsal bristles, the pectinate uncini, the flexuous calcareous tube incrusting *Zostera* and other marine organisms, and the hermaphrodite condition, there is nothing diagnostic. Thus Langerhans subsequently showed that even the number of the thoracic segments varied in this form from seven to nine. The presence of eyes again corresponds with the condition in *Filograna implexa* and *Salmacina dysteri*, as also does the structure of the first pair of thoracic bristles; though the bolder character of their serrations above the "knee" indicates variation, it may be from environment, whilst the absence of serrations in the tapering blade beyond the hiatus in Claparède's description and figure is due to the artist, for they are present in specimens from Naples. The description and figures of the two other forms of bristles agree with the conditions in *Filograna*; and the same may be said of the abdominal bristles and the structure of the hooks. Claparède found in one a double tip to the tail with two cirri, perhaps the result of injury.

He regarded the anterior glands (nephridia) as the secretory organs for the tubes. Further, he describes the hermaphrodite animal as provided with orange ova in the anterior region of the abdomen, and zoosperms in the posterior, even to the extremity, and the sperms had an elongated head. Such an arrangement therefore differs from that usually observed.

* *Op. cit.* p. 436.

† Echeniod. Actin. u. Würmer, p. 62.*

‡ Catal. Conch. reg. Neapol. p. 19, 1836 (*vide* Claparède).

In the 'Supplement to the Annelids of Naples' (1870) Claparède * repeats the generic characters he had previously given, only adding that spatulate or pectinate bristles are absent from the posterior region. He also differentiates *Psugmobranchus* more definitely from *Salmacina* by the entire absence of buds in the former, and by the hermaphrodite condition in *Salmacina*, which is to all intents and purposes, he says, a *Filograna* deprived of its operculum.

In this publication he describes a new species, *A. edificatrix* †, characterized by the whitish granular tubercles along the exterior of the filaments, the absence of eyes, and the presence of nine thoracic segments, the other features being common to it and the other species. He states that this form is very near *S. incrustans*, which is found adhering throughout its length to the surface of Fuci and other marine plants, to the surface of shells, and other bodies, whereas *S. edificatrix* is a deep-water form which constructs masses, by the branching and anastomosing of its tubes, identical in structure with those of *Salmacina dysteri* (from which the Neapolitan form is readily discriminated by the absence of enlargements at the extremity of the branchiae), and so with *Filograna*. He thinks the structure of *S. edificatrix* leaves little doubt to its reproducing by posterior buds.

In his figure of the collar-bristles he is more accurate than Langerhans, the number of serrations on the flattened basal region being seven, and the hiatus is more in accordance with Nature; yet the bristle, as a whole, does not differ in any way from that of *Filograna*. The other segments carry bristles which do not differ from those of *S. incrustans*, and, it may be added, from those of *Filograna*. He holds that the hooks differ from those of *S. incrustans*, but it cannot be said that his figure (pl. 13. fig. 1, E) represents a full lateral view of the organ, but rather a partial lateral view, thus giving it greater length proportionally than it really has. These small organs are not readily mounted so as to exhibit a complete lateral view, and thus the able Swiss author was misled. They seem to agree with all the other forms examined.

Amongst other features, the author states that the achetous region between the thorax and the first abdominal bristles is equal to four or five segments, and that the abdominal bristles are capillary and winged, with a "knee" at the

* P. 154.

† P. 157, pl. xiii. fig. 1.

tip. At the base of the branchial pinnæ are rows of granular cushions, but all he says about the extremity of the filaments is that they are bare, and in his drawing they are somewhat delicately tapered.

Giard* (1875 and 1876) made two notes on the development of *Salmacina dysteri*, Huxley, with figures, from the early ovum to the post-larval stage, having three pairs of bristles. The description and figures of this able and industrious author are excellent.

Langerhans † (1880) describes *Salmacina incrustans* from Madeira as occurring in tubes on stones between tide-marks and on fish-baskets. The terminal process of the branchiæ has a coloured cushion composed of epithelial cells and at the tips of the pinnæ "einige solche Zellen." In the Mediterranean form these cells were absent. A pair of eyes; five to seven setigerous segments anteriorly, the first bearing the characteristic bristles, one of which he figures with five serrations on the wide basal process below the hiatus (Taf. v. fig. 40 b), and the other with a serrated edge devoid of a hiatus, but Neapolitan examples of the species show smaller and more numerous serrations on the basal web of the tip, viz., about double the number indicated by Langerhans, and the hiatus is less pronounced. This remark is made on the supposition that the form from Madeira is the same as that at Naples. The ventral uncini have only five teeth above the main fang, whereas in *S. ædificatrix* there are six; yet in the figure of the face of the hook in each case there are nine transverse rows. The anterior bristle with the curved (sickle-like) tip and serrations is also present, though the figure is indifferent. Bristles with smooth wings occur in this region, but he does not indicate any differentiation at the tip of the tail, though he describes those of *S. ædificatrix* as having serrated wings. In the Neapolitan examples the serrations of the tip were less prominent.

Carus (1885) distinguishes *Salmacina* thus: Thoracic membrane; branchiæ equal, base circular, destitute of an operculum. First thoracic segment with a tuft of bristles larger than the succeeding and of a distinct form, semicrenulate. From the third segment, besides winged setæ, are others semicrenulate. Spatulate and pectinate bristles absent from the abdomen—only simple falciform bristles.

He makes Claparède's *S. incrustans* synonymous with ? *Serpula filigrana*, Sacchi, and so with ? *Serpula intricata*,

* Comptes Rend. Acad. Sc. 17 January, 1875, and 24 January, 1876. Also 'Œuvres Diverses,' p. 316.

† Zeitsch. f. wiss. Zool. Bd. xxxiv. p. 122.

Grube, though the latter conclusion is unlikely. The body is 2-2.5 mm. long, of an orange colour; thoracic segments 8; dorsal bristles of two kinds; uncini pectiniform; tube sinuous and calcareous, incrusting *Zostera* and other marine structures. There is no diagnostic feature in this description.

S. edificatrix. Body dull orange, 2-2.5 mm. long, segments 45-50; branchiæ 4, white, with pale granular tubercles externally; no eyes; thoracic segments 9; collar-bristles geniculate, cuspidate at the base of the wings; rest of the segments have subulate bristles with wings, others pectinate; falciform; hooks small, multidentate; tube capillary, densely glomerate, and intricate.

Cunningham and Ramage* (1887), while giving no details, have a figure of an adult example and a larva of *Filograna implexa*. The adult has eight pairs of anterior bristles, a pair of eyes, and opercula on the branchiæ. The larva has three pairs of bristles, two large eyes, and a prominent prototroch.

Ehlers† (1887) examined a form from the Tortugas which he named *Filograna huxleyi*; having the general structure described by previous authors, with ova in the posterior segments (12-20), and in the case of a nurse-stock, from the seventh posterior segment of which a bud of six thoracic and seven abdominal segments arose, there were no reproductive elements. Each branchial filament, as in *Filograna dysteri*, ends in a pear-shaped, cellular, flattened swelling with palpcils. He considers such an organ may be connected with food-supply, since he found a *Nauplius* amongst the pinnæ. The stomachs, however, of most examined in Britain had only such objects as currents supplied, and in those from deep water Cocoliths were common, and so with many foreign forms. Ehlers states that Huxley describes certain warts on the branchiæ of his species, but they were not present in the American form. The homologues of the terminal enlargements with opercula or eyes (e. g. in *Branchiomma*), as Langerhans considered in *Salmacina incrustans*, are referred to. Ehlers gives a figure of the characteristic collar-bristles which differs from anything hitherto seen in the group, in so far as it has only six large serrations to the basal division of the wing, no hiatus, and a long, smooth, tapering tip. Further, no bristle

* Trans. Roy. Soc. Edin. vol. xxxiii. p. 673, pl. xlv. fig. 35.

† "Report on the Annelids of the 'Blake,'" p. 314, Taf. 56, figs. 4-9

with a reaping-hook curve is present in the succeeding segments, only those with a "knee" and an ordinary winged tip. The hook agrees with that found in the common *Filograna*, though the artist has not represented the streaks at right angles to the serrations. The earliest bud has only segments similar to the abdominal of the parent.

He considers his species near Huxley's *Protula dysteri*, though it has no eyes; both have the terminal organ of the branchial filaments. So far as can be seen, there is nothing in Ehlers's description to distinguish his species from *Filograna implexa*.

Lo Bianco* (1893) mentions the following hermaphrodite forms: *Amphiglena*, *Salmacina*, *Spirorbis*, *Pileolaria*, &c., the ova being deposited in the interior of the tube or placed in the operculum; the young by-and-by forming colonies by fission. Fis-iparous reproduction occurs in *Salmacina* and *Telepsarus*.

In 1894 De St. Joseph† made a contribution to the history of this species (*Salmacina dysteri* variety), which he dredged frequently on shells, on *Rytiphlea pinastroides*, and collected on rocks and stones at Rochardien. He gives the size as 6 mm., and shows how in many features it resembles *Filograna implexa*, only it has no operculum. He further states that each branchial filament is terminated by a peculiar enlargement formed by a double row of cells with palpocils, the latter also occurring on the pinnæ. The segments of the anterior region (thorax) range from seven to nine, and have bristles and hooks resembling those of *Filograna implexa*. The naked region behind the anterior has ten or twelve segments, whilst the posterior region (abdomen) has from 40-50 segments, the middle being narrowed, and the anterior and posterior parts dilated, the tip again narrowing to the two terminal papillæ. The bristles agree with those of *F. implexa*. The alimentary canal, the blood-sinuses around the gut, and the excretory organs anteriorly debouching by a common aperture are all in accordance with the parts in *F. implexa*. He found ripe eggs and ciliated embryos in the cœlomic cavity, proving that impregnation is internal, the earlier atrophic forms of similar size to the eggs, and with two minute eyes in front; besides others more advanced, with a ciliated collar behind the eyes, three setigerous segments, and an anal. No hooks are present. This stage he thought anterior to that described by Giard in

* "Gli anellidi tubicoli trovati nel Golfo di Napoli," *op. cit.*

† *Ann. Sc. Nat.* 8^e sér. t. xvii. p. 340, pl. xiii. figs. 375-380.

the tube of the parent. Moreover, *S. dysteri* reproduces by buds, as in *F. implexa*, the nurse-stock of seven or eight anterior and fifteen to seventeen posterior segments, without sexual elements, giving rise to a bud at the eighth or ninth posterior segment as in *Filograna implexa*. He concludes by stating that *S. dysteri* is met with in different conditions:—

1. As a hermaphrodite form without buds, measuring 6 mm., with the anterior segments of the abdomen enclosing the male and female sexual elements, the following segments constricted, and the terminal enlarged.

2. As a short annelid of twenty posterior segments, without the filiform portion of the abdomen and which prepares for budding, or perhaps has already budded and regenerated, the detached segments.

3. As a form of the same size as the preceding with a bud at the eighth or ninth posterior segment.

4. As a shorter form from which a bud has been detached, which possesses only nine or ten posterior segments and is devoid of eyes.

In regard to the resemblances between *Filograna implexa* and the present species, they are identical except for the absence of the opercula in *Salmacina*. He mentions the case of the *Protula* described by Fritz Müller, which acquired an operculum on one of its pinnate branchiæ; then the barbules disappeared, and the filament became the stalk of the operculum. In *Salmacina dysteri* at complete maturity he found each of its branchiæ terminated by a mass which offered no indication of an operculum; and, since *Filograna implexa* at complete maturity retains its two opercula, he is of opinion that the two species are stable and distinct. Yet this very statement shows that between *S. dysteri* and *S. ædificatrix* there is a facile step on this head alone.

In referring to the proposal of Ehlers to suppress the genus *Salmacina*, Claparède, since its bristles resemble those of *Filograna*, De St. Joseph would conserve the genus *Filograna* as revised by Ehlers, but would divide it into two subgenera—viz., *Filograna* with an operculum and *Salmacina* without one.

De St. Joseph found on the tubes *Folliculina ampulla* and *F. atropurpurea*, anastomosing amongst them and the minute sponges, and Corynids and ova were also present. He observes that the dorsal hooks in the posterior region resemble the thoracic ventral hooks, but their rows are short and their number few.

Malaquin * gives also an account of the sexual and asexual phases of *Salmacina dysteri* :—

I. Phase of a young protandrous form. The male genital segments are incorporated with the thorax, and are sterile.

II. Phase is that of asexual reproduction, or schizogenesis. In this the animals present incomplete male sexuality, manifested by the production of a few spermatozoa which attain maturity.

III. Phase—hermaphroditism. Gonads (male and female) are situated in distinct segments—the male in the three (two to four) anterior abdominal segments, the female in the eight to ten segments which follow. The circulation in *Salmacina* and *Filograna* resembles that of the Serpulids in the particular reticulation of vessels distinct from the coelom. There are branchial and ventral vessels. Around the intestine is a vascular sinus, as in Serpulids and Sabellarians. In *Salmacina* and *Filograna* this sinus lies between the endothelium splanchnoplaïque of the coelom and the intestinal epithelium. This part of the hæmocele represents exactly the primitive blastocœle.

The same author † (1911) gives an elaborate disquisition on the phases of *Salmacina*, grouping them as follows :—

I. The sexual forms, including the young protandrous forms, with three to five segments in the thorax, two intermediate, and six abdominal segments. II. The unisexual, rarely female, less rarely male. The female is $2\frac{1}{2}$ mm. long, with three thoracic segments, an intermediate aseptigerous segment, and six to eighteen abdominal distended with ovocytes. Probably this becomes hermaphrodite. The male is $1\frac{3}{4}$ – $2\frac{1}{2}$ mm., with seven thoracic segments, sixteen ripe abdominal segments, and three or four terminal.

The hermaphrodites have eight branchiæ, eight thoracic segments, then two or three aseptigerous segments ; immediately behind are two or three with male gonads, and the succeeding ten have female gonads with red ova. They reach 6–7 mm., and may have fifty abdominal segments. In some hermaphrodites male elements predominate, the female segments being reduced. In others a hermaphrodite segment occurs at the limit of the male region, the male elements being on one side, the female on the other. He has also seen a hermaphrodite gonad.

The metacere, as a rule, is unisexual, but, as mentioned, between the male and female regions a hermaphrodite one

* Assoc. Française Adv. Sc. Lille, 1903, p. 135.

† Zool. Anzeiger, Bd. xxxvii. p. 201.

may occur. A large well-developed ovum may appear in the coelom and a male gonad in the segment.

In *schizogony*, in its asexual phase, it is exceptional to find seven segments in the thorax. At the tenth abdominal segment cephalo-branchial proliferations occur with two new segments of the thorax, instead of the three or four of the oozoite. No sexual elements appear. In *schizogony* accompanied by sexuality male elements are found in the abdominal segments (9-10), such probably being a further stage of the protandrous young. In the hermaphrodite forms the elements are reduced in quantity—for instance, in a schizoozoite of twenty segments.

He makes the noteworthy remark that schizogonous individuals by their size and the number of their segments are little advanced in age compared with the hermaphrodite forms. Another fact is that when sexuality is present it is reduced male, female, or hermaphrodite. These are stages in the march to complete hermaphroditism.

Malaquin concludes that *Salmacina dysteri*, Huxley, exhibits all the forms of sexuality possible. It, indeed, shows a kind of indifferentiation in sexuality, marked by the absence of secondary sexual characters in the individual. The sole character which distinguishes the phases from each other is the position of the genital segments and their state of advancement. Schizogony occupies the middle period of the existence of the annelid. It is intercalated between the two sexual periods—protandrous or rarely female, or hermaphrodite. The sexual period ultimately marks the end of the evolutionary cycle in *S. dysteri*. The exclusive sexual form is hermaphroditism. In a certain number of these the male elements predominate. It thus reappears in the life-cycle after its presence in the young oozoite.

Miss Pixell* (now Mrs. Goodrich) describes *Salmacina dysteri* from Gough Island, in the Antarctic Sea, as occurring in fairly large masses. No buds were present. She also finds the same species in various parts of the Indian Ocean†.

Fauvel‡ (1914) describes *Filograna implexa* from the Gulf of Gascoigne, Monaco, and other sites, the agglomerated tubes forming considerable masses analogous to those of *Salmacina dysteri*, from which, he observes, the animal is easily distinguished by its two opercula. The same author alludes to *Salmacina incrustans*, the very fine tubes of which

* Trans. Linn. Soc. vol. xvi. p. 87 (1913).

† Trans. Roy. Soc. Edin. vol. xlix. p. 350 (1913).

‡ Campag. Sc. Monaco, Fasc. xlv. p. 327. I am much indebted to Prof. Fauvel for specimens and memoirs.

are more or less agglomerated on stones or shells. Certain specimens have the branchiæ coloured red at the extremities—an accidental condition. The collar-bristles have the web at the base of the tip with large teeth (two or three prominent) and with a few capillary bristles. There is no operculum. The uncini have numerous teeth. He distinguishes *S. dysteri*, Huxley, from the foregoing by the numerous fine teeth on the basal web of the collar-bristles. All the specimens had sausage-like cellular masses at the tips of the branchial filaments. He was of opinion that the *S. ædificatrix*, Claparède, was the same species. He never encountered a true representative of this species, which, he says, is distinguished from *S. dysteri* by the absence of the enlargements at the tips of the branchial filaments, and adds, strange to say, that the tubes are often intertwined with those of *Filograna impleta*.

J. H. Orton* (1914) states that the common species of "*Filograna* carries ripe eggs and trochospheres at an age probably less than 4 months, having grown through the summer. About the same time another experiment yielded specimens with fully-developed eggs at an age not greater than 10 weeks and 4 days. Later in the year full-sized specimens with buds had an age not greater than 4 weeks and 2 days. There can be little doubt, therefore, that in this species there is an alternation of generations, the summer forms producing eggs and sperm, and the autumn and winter ones producing buds."

(6) FAUNISTIC.

In order to give a satisfactory view of the remarkable variations of *Filograna*, it is necessary in the first instance to glance at the condition of the specimens from the several grounds, which range from Shetland to the Channel Islands in Britain, and elsewhere from diverse distant localities stretching almost from pole to pole †.

In those from Plymouth no operculum has been seen up to date. In an example with a bud the branchiæ had short pinnæ, but the tips had sausage-like enlargements; the anterior region had seven lateral bristle-tufts besides the collar-tuft, two segments succeeded the anterior region without bristles; thirteen bristled segments followed; then the bud, the first two segments of which had no bristles, and twenty-three with bristles succeeded, two papillæ occurring posteriorly. Its branchiæ were simple filaments. In

* Jour. M. B. A. vol. x. p. 316.

† Those from the area of the Clyde was sent by Mr. L. Renouf of the Museum and Laboratory at Rothsay.

older examples without a bud the anterior region had seven pairs of bristles besides the collar pair, a considerable smooth region, and fifteen segments and the pygidium posteriorly. The branchiæ were well developed, with sausage-shaped enlargements of the tips of the filaments, and the pinnæ were much longer than in the former. The apertures of some of the tubes show a slight expansion like the muzzles of old-fashioned shot-guns for sparrows, whilst others have cylindrical though rounded margins. In the first series of bristles, which in lateral view have the tip at an angle to the shaft, the basal part of the wing has numerous (fully a dozen) serrations sloping from the base to the distal end in lateral view, and then a hiatus, followed by a minutely serrated tapering blade. When viewed from behind, the shaft diminishes little to the end of the basal section of the wing, and the axis can be followed, as distinct from the wing, from the base to the tip, and then gradually tapers distally. Certain views point to the double nature of the basal expansion, serrations being seen on both sides. It may be that something similar exists in the distal wing. What have been mentioned elsewhere as simple bristles in this tuft are apparently only developing forms of the special type.

Channel Islands (off Guernsey and between tide-marks, Herm).

Most form fixed tubes on shells and stones—two opercula, as a rule, on each; these may be large and thin, or less expanded as circular discs. No enlargement of the tips of the other filaments. This form is common under stones (to which it is attached) between tide-marks in the Channel Islands. Ova occur in the posterior region of body. In the structure of the collar-bristles no distinction can be drawn between these and the Plymouth forms. The shaft, basal wings, and tip are the same. The hiatus and the mode of origin of the distal part of the wing agree, as also do its minute serrations.

St. Andrews.

Branchiæ without an operculum in two bearing buds tips of branchiæ cylindrical in some, in others slightly clavate (in the spirit-preparations). The condition of the branchiæ depends on age; in young examples the filament and pinnæ are short, but they vary, some of the same size of body having larger and better-developed branchiæ. The young have a short body. The collar-bristles show several with curved tapering tips, which do not have the ga-

separating the widened and more boldly serrated base from the more minutely serrated terminal region. The structure of those with the gap, however, does not differ from that of the Plymouth form. The buds presented a similar condition, and the serrations of the basal region of the tip were bolder than the distal. In some of the unaltered tips slight hollows at the site of the gap indicated a change. Further, in addition to the foregoing, a series of simple tapering bristles without evident wing were present.

Off the Hebrides.

Two well-developed opercula of a flattened finger-nail shape. Series of rounded eye-specks. No enlargement of the terminal processes of the branchial filaments; long body; eight pairs of anterior bristles. Collar-bristles apparently agreed with the St. Andrews form.

S.E. of the Isle of May. August. 32 fathoms.

Two opercula, circular and rather small. No enlargement of the tips of the branchial filaments, and the pinnæ comparatively short. Ova in some with comparatively short bodies. Collar-bristles apparently similar to those from St. Andrews.

Shetland.

Two opercula (small and round) in some, others have none. The examples are small. Collar-bristles similar to those from St. Andrews.

Moray Frith (dredged).

Well-formed thin opercula. In another none. No enlargement of the tips of the branchial filaments in either. The collar-bristles in these forms agree with those from St. Andrews.

Aberdeen Bay. August.

Well-marked opercula in all. No enlargement at the tips of the branchial filaments. Collar-bristles indistinct, but apparently agreeing with those from St. Andrews.

H.M.S. 'Triton' and 'Knight Errant.' 530 and 87 fms.

An operculum is present in these as a rule, but it is a very thin circular plate—so thin as to be distinguished with difficulty in certain examples. No eggs, sperms, buds, or larvæ were seen in these specimens in August. Numerous coccoliths occurred in their stomachs. The specimens from both ships had exactly the same structure in the collar-bristles as at St. Andrews.

*North Sea**.

Station 18 a. 455 m. No. 29. 18.6.1906. Procured with the small trawl.

The shelly tubes of this form exactly resembled those of the other varieties. The annelids, whose bodies were of moderate length, are characterized by the free development of the branchiæ, which possess large filaments, and long and rather slender pinnæ with scarcely a trace of enlargement at the tips. The filaments do not appear to show any glandular thickenings such as occur in *Salmacina ædificatrix*. At the extremities the filament, which is comparatively broad at the last pinna, gradually tapers to a blunt point.

In one example with eight pairs of anterior bristles the two dorsal filaments were modified in an interesting manner, since one presented a somewhat thick terminal process, the tip of which was abruptly bevelled mainly on one side, the tapering tip being rather blunt, its cellular structure otherwise remaining the same as its neighbours; whilst the other had advanced a stage further, the clavate tip being unequally bevelled and hollowed so as to form a rudimentary operculum. This example carried over well forward in the posterior region, but as it was imperfect, too much reliance need not be given to this feature. The region frequented by this colony seemed to be highly favourable, for in another example the tips of the branchial filaments were irregularly enlarged.

Station 18 a. 14.3.1907. Trawl.

Eyes present.

The type consisted of comparatively short bodies, with seven pairs of anterior bristles, and about twenty-five segments posteriorly, comparatively long branchial fans—fully half the length of the body, and with opercula. The form of the opercula, however, varied considerably from the thin, translucent, and more or less circular or hoof-shaped cup to a long vase with a tapering process on the lip, a bluntly clavate termination, or a cone at the end of the filament. The short bodies are terminated by the two anal papillæ. So far as could be observed, no reproductive elements were present. Food was abundant in the stomach, and the intestine had the elliptical faecal masses.

The structure of the collar-bristles is identical with that in the St. Andrews examples.

Station 10. 27.5.1907.

These were characterized by small, thin, wineglass-shaped

* I am indebted to Prof. D'Arcy Thompson for the opportunity of examining these.

opercula, seven pairs of anterior bristles, short pinnæ to the branchiæ, the filaments of which had rather short, stumpy, terminal processes, and by the great number of small ova, which in some stretched far forward. The number of the small ova far exceeded that seen in any other form, and point to their probable extrusion before fertilization, or, at any rate, immediately after. Sperm were not clearly demonstrated in front, but they may have been present, though in one the ova passed forward to the anterior region. This form also shows the isolated and elliptical fecal balls in the posterior part of the gut. In structure the collar bristles correspond with those from St. Andrews.

Station 16 a. 195 m. No. 202. 9.6.1908.

Some had no opercula, others had two of the ordinary funnel-shape. In several without opercula the tips of the filaments were rather short and little tapered. In another the tips of the two dorsal filaments were flattened and wider than the rest. The number of the anterior bristles was seven pairs.

One presented the same circular or rounded granular masses on each side of the gut in the caudal region. Others showed distinct ova (small). The former is probably the early condition of the latter. In structure the collar-bristles agree with those from St. Andrews.

Station 16 a. 324 m. 13.6.1908.

The examples have slightly larger tubes, more laxly put together, and often showing a lip where the annelid protrudes—that is, the edge of the tube is expanded a little and turned over. The annelids have no opercula, and rather long tapering tips to the branchiæ, which also have long pinnæ. The collar-bristles have the same structure as those from St. Andrews.

Station 18 a. 324 m. 13.6.1908.

These have seven or eight pairs of anterior bristles, long branchiæ, with transparent opercula, and long pinnæ on the filaments, which in those having opercula showed no enlargement. In one about twenty of the terminal segments contained rounded granular bodies like early ova. In young forms seven pairs of anterior bristle-bundles occurred, and the branchiæ had short pinnæ and thick filaments. The posterior region in these had between twenty and thirty segments. The tips of the non-opercular filaments were rather long and tapered. In those with the granular masses posteriorly, no large ova could be seen. The aperture of

the tube is in some expanded a little and turned over. The structure of the collar-bristles is precisely the same as in the St. Andrews examples.

Station 18a. 455 m. 18.6.1906.

The tips of the branchial filaments are enlarged as flattened lobate processes in every instance, and in several the expansion passed down the filament for some distance. The pinnæ on these filaments were all rather long and slender, and in marked contrast, for instance, to those from Plymouth, in which the short thick pinnæ are diagnostic, the whole branchial apparatus being less developed. The great length and the number of the pinnæ in the form from the North Sea give the branchiæ a densely capillary aspect. As a rule, the terminal pinnæ are shorter and thicker, partly, in all probability, from more active growth. Besides the examples just mentioned others showed similar enlargements at the tips of the filaments and no opercula; whilst in a third series a minute, flattened, or slightly saucer-shaped operculum appeared on each dorsal filament. Such could have been of no service as a protection. The structure of the collar-bristles of these specimens corresponds exactly with that of the St. Andrews form.

Station —. Off Moowick Head, 99 m. No. 165. Captured in trawl. 12.8.1908.

All these presented the rounded granular masses (early ova) on each side in the caudal region, and no ova in front. Opercula were present, and seven or eight pairs of anterior bristles. In structure the collar-bristles agree with St. Andrews examples.

Station —. 15.8.1908.

Those examined had two opercula and no enlargements at the tips of the branchial filaments. The anterior bristles were seven or eight, the young having fewer. The collar-bristles agree with those from St. Andrews.

'Porcupine,' 1870. 45 fms. off Cape Sagres.

In these examples the branchiæ are of moderate length (about that of the specimens from Plymouth) and furnished with two well-formed opercula. The pinnæ are somewhat more slender than those from Plymouth. Moreover, most or all of the opercula had a little process on the edge of the comparatively large organ. The rest of the filaments ended in a tapering tip. There were eight pairs of anterior bristles. The collar-bristles are minute and transparent, but the basal region of the wing is differentiated and serrated as

usual, then a gap occurs, after which the distal finely serrated wing tapers to a slender point. These bristles are more minute than any hitherto examined.

Norway.

These have large branchiæ, no opercula, and the tips of the filaments are comparatively short, not expanded, whilst the pinnæ are numerous. No sperms were seen, but ova occurred in the anterior region of the abdomen. There were seven pairs of thoracic bristles. Here then was a variation from the form described by Sars which had two opercula. The structure of the collar-bristles entirely agrees with that of the St. Andrews examples.

Naples. (*Salmacina edificatrix*, auct.)

The comparatively large size of these examples and the great development of the branchiæ, their glandular swellings along the filaments, and the large size of the sausage-like tips, as well as the common occurrence of nine pairs of anterior bristle-bundles make them conspicuous. The pinnæ also take on the tendency to increase at the tips, especially the distal pinnæ, yet these pinnæ are not so long as in certain forms from the North Sea, also devoid of an operculum. The development of the axis or filament of each branchia is in contrast with the smaller parts in the northern seas, the glands of the filaments being smaller. The points or main fangs of the minute hooks appear to be directed forward—both in the anterior and the posterior regions. So far as can be seen, the sperms occur behind the bare segments of the anterior part of the posterior region, and in one with embryos they seem to pass backward, some being present at each side of the tail. In this example (with embryos and ova) the tips of the branchiæ showed rather less than the usual enlargements. The granular masses at the sides of the tail, however, may be sperms. Yet they resemble the granules in front. In those with advanced embryos most of the sperms appear to be shed.

The collar-bristles agree in structure with those from Plymouth and the north, having a basal division of the wing with numerous serrations, a gap, and a tapering distal region with a minutely serrated edge. The bristle has the same curvature at the end of the shaft. Ten points at least appear in a favourable view of the basal web of the collar-bristles and the others agree with those of the northern types.

Dongonab, Red Sea. 2.12.1915.

The vermidom is of the open pattern, so that aeration

goes on readily, yet it is stated they grow in quiet nooks at Dongonab. The long branchiæ are richly pigmented, and each animal is provided with a pair of eye-specks composed of a group or crescent of four or five points. The web at the base of the tip of the collar-bristles has eight or nine teeth. The tips of some of the branchiæ in a few are enlarged. In others this is not seen. One had more slender pinnæ than usual, and in this the tips of two of the filaments presented enlargements of the sausage-shape with lateral gland^s as in *S. edificatrix*. All have six pairs of anterior bristles, viz. first and five following. No opercula are present. One or two buds (early) were attached to the nurse-stock; and many young forms occurred. Buds thus develop in the quiescent condition of the reproductive elements, which were not visible.

Dongonab, Red Sea. 2.2.1916.

Since December (1915) the reproductive elements have been developed, the large ova occurring in masses in the non-bristled region behind the "thorax," leaving the posterior and caudal regions free. In some the spaces between the septa were filled with a uniformly granular mass. In a small form, which seemed to be male, the elements filled the posterior and caudal regions to the tip, whilst anteriorly the masses reached the thoracic border. No buds were observed in this series. The tips of the branchial filaments were slightly enlarged in some ovigerous forms, the outline being ovoid rather than sausage-shaped as in *S. edificatrix*, and in this respect they agreed with those procured in December, and in which the reproductive organs were not developed; indeed, some of the latter had large processes, so that this does not appear to be connected with the development of the gonads. The young as well as the adults presented the same slight enlargements of the terminal processes of the branchial filaments.

Dongonab, Red Sea. 5.1916.

Since February the reproductive elements in the body have disappeared, and more frequent instances of budding present themselves, the buds arising in a similar manner from the posterior end in front of the pygidium which forms the anal extremity of the bud. The tentacles develop early, and enable the eye to detect the bud even when very small. At a little later stage the outline anteriorly is marked by a separate and symmetrically shaped area—apparently the rudiment of the "thorax."

Dongonab, Red Sea. 9.1916.

Many of the tubes were empty, and the forms were young.

In the Red Sea *Filograna* produces ova in the coldest month of the year. In the same region Dr. Crossland* found that *Meleagrina vulgaris* sheds ova in the winter, whilst *M. margaritifera* breeds only in the summer. The same careful observer remarks that he has not yet seen *Filograna* amongst coral, but it is common on buoys, on the bottoms of boats which have been standing in the harbour, on piles in sheltered water, and in sponges. All its habitats in shallow water are sheltered, and the fragility of the calcareous tubes probably render this necessary.

Madras Harbour, India †.

Tubes of the same form were dredged by the late Dr. John Anderson east of Verribles, India, in 13 fathoms.

The branchiæ of those from Madras Harbour show slight enlargements at the tips of the filaments. Though the preparations were not very favourable, yet in an example one of the tips exceeded the others in size, but had the same structure. As a rule, the tips are probe-pointed, though in some the terminal cushions are larger and more boldly glandular. From seven to eight pairs of bristles occur in the anterior region. So far as could be observed, the structure of the collar-bristles is typical.

Sydney Harbour, Australia. 4.1916 ‡.

The specimens are characterized by the blackish colour of the branchiæ—especially their distal ends, which thus boldly contrast with the white tubes, and the anterior region of the body in some is also of a dark hue. The branchiæ appeared to be comparatively thick and stumpy, the pinnæ in some and the terminal process of the filament devoid of enlargement, though it was stout. All had two eyes. The number of the bristle-bundles of the anterior region was usually nine, young forms had eight. There were no opercula. The collar-bristles agree with the type found at St. Andrews.

* To whom I am greatly indebted for these and many other specimens.

† For the examination of these I have to thank Dr. Annandale.

‡ Kindly forwarded by Prof. Haswell.

§ Whether osmic acid had been used for killing is as yet unknown.

Some had the posterior region of the body distended with large ova. None had buds, but a band or two of large free ova in mucus occurred, as in the specimens at St. Andrews and as is also found in *Spirorbis*. Some of the tubes of mucus contained larvæ with three pairs of bristles, a powerful prototroch, two large eyes, and a segmented body.

A commensal Crustacean was found in the calcareous tube.

PLYMOUTH.

Operculum (none).	Branchiæ (tips).	No. of bristles.	Serrations of anterior basal web of collar-bristle.	Gonads*.
....	Slight enlargement.	7	About 12.	Ripe sperms.
....	No distinct enlargement	6	Fewer than 12.	....
Larger example ..	Enlargement greater.	8	About 10?	....
<i>March.</i>				
Young specimen .	Enlarged tips.	8	" or more	....
Very young ....	....	8	"	....
Young	Enlarged tips.	8	"	....
<i>June.</i>				
With bud	"	7	"	....
Fairly adult	"	8	"	....
"	"	8	"	Ova.
"	"	8	"	Ova.
" (short post. region) ..	"	9	"	....
Fairly large	"	7	"	Ova.
" with bud.	"	8	"	....
" " Slight.	"	8	....	....

GUERNSEY.—JULY.

Opercula.	Branchiæ. Sausage-tips.	Anterior bristle-tufts.	Collar-bristles. Basal comb.	Remarks.
....	1	7 pairs.	About 1 dozen serrations.	....
2 opercula.	....	8 "	About 1 dozen.	....
2 "	0	7 "	"	Branchiæ pig- mented brown (or red?).
1 only visible. ....	.... 2 or more.	6 8?	" 1 apparently with fewer teeth.	.... On shells.
2 opercula.	....	8	....	....
2 "	....	7	....	On shells.

* The male elements were present in the majority with ova.

ST. ANDREWS.

Opercula.	Branchiæ. Sausage-tips.	Anterior bristle-tufts.	Collar-bristles.	Remarks.
....	All with sausage-tip (long).	7	Fully 1 dozen fine serrations.	Large example.
	....	8	....	....
Bud.	Slightly enlarged tip.	7 (developing).	No distinct notch.	Apparently fine teeth.
....	....	7	....	June.
....	....	8	....	"
....	....	8	....	"
....	Slightly enlarged tips in two specimens.	....	....	"
developing.	....	7	....	Bud, September.
developing.	....	7	....	" " "
developing.	....	7	....	Nearly adult, " September.

OFF HEBRIDES.—JULY.

Opercula.	Branchiæ. Sausage-tips.	Anterior bristle-tufts.	Collar-bristles. Basal web serrated.	Remarks.
Large example, 2.	8	....	Pigment on branchiæ, two eyes.

OFF ISLE OF MAY.

Opercula.	Branchiæ.	Anterior bristles.	Collar-bristles.
2	With pigmented tips.	7	Web with small teeth.

OFF SHETLAND.

Opercula.	Branchiæ.	Anterior bristles.	Remarks.
young, 2.	No enlargement of tips.	7	Ova.
adult 2 or none.	....	....	....

MORAY FRITH (DREDGED).

Opercula.	Branchiæ. Sausage-tips.	Anterior bristle-tufts.	Collar-bristles.	Remarks.
2	None.	7	Typical.	....
2	None.	8	"	Ova.
1	Very slight enlargement.	8	"	....

ABERDEEN BAY.

Opercula.	Branchiæ.	Anterior bristles.	Collar-bristles.	Remarks.
2	No enlargement of the tips.	7	Small teeth (12).	Ova.

PORT ERIN.

Opercula.	Branchiæ.	Anterior bristles.	Collar- bristles.	Remarks.
None.	Tips of filaments black.	8-9	Typical.	....

'KNIGHT ERRANT,'—AUGUST.

Opercula.	Branchiæ.	Anterior bristles.	Collar- bristles.	Remarks.
2	7	Typical.	Coccoliths in stomach.

NORTH SEA.

Opercula.	Eyes.	Branchiæ.	Anterior bristles.	Collar- bristles.	Remarks.
Stat. 18 a.					
18.6.06. 2 or none.	....	Largely developed, no enlargement at tip.	8	Typical.	Ova.
14.3.07. 2.	Present.	No enlargement of tip.	7	"	....
Station 10. 2.	....	" "	7	"	Ova numerous and small
Stat. 16 a. 2 or none.	....	" "	7	"	Ova.
13.6.08. None.	....	" "	7	"	....
Stat. 18 a.					
13.6.08. 2.	....	" "	7-8	"	Ova.
Stat. 18 a.					
18.6.06. 2 or none.	....	Those without oper- cula had enlarged tips to filaments, which were long and slender.	7	"	Sperma.
No. 165.					
12.8.02. 2.	....	No enlargements.	7-8	"	Early ova?
15.8.08. 2.	....	" "	7-8	"	Sperma.

'PORCUPINE,' 1870.

Opercula.	Branchiæ.	Anterior bristles.	Collar-bristles.	Remarks.
2 with a minute process.	Slender pinnæ; no enlargement.	8	Typical though minute.	....

NORWAY.

Opercula.	Branchiæ.	Anterior bristles.	Collar-bristles.	Remarks.
2 or none.	Large branchiæ in those devoid of opercula, no en- largements at tips.	7;	Typical.	Ova and sperma?

NAPLES.

Opercula.	Branchiæ.	Anterior bristles.	Collar-bristles.	Remarks.
Absent.	Large sausage.	10	Basal web. About 10 or 12 serrations.	Ova.
....	" "	9	....	Embryos

DONGONAD, RED SEA.

Opercula.	Branchiæ.	Anterior bristles.	Collar-bristles.	Remarks.
2nd December. None.	Pigmented, some tips enlarged.	6	Basal web, 8-9 teeth (typical).	Buds in a few.
2nd February. None.	Tips of branchia slightly enlarged both in young and adults.	6	Typical.	No buds.
May. None.	" "	6	"	Many buds.
September. None.	.....	....	....	Young examples.

MADRAS HARBOUR.

Opercula.	Branchiæ.	Anterior bristles.	Collar-bristles.	Remarks.
None.	Tips slightly enlarged.	7-8	Typical.	....

SYDNEY HARBOUR.

Opercula.	Branchiæ.	Anterior bristles.	Collar-bristles.	Remarks.
None.	Pigmented branchiæ, no enlargement.	9	Typical.	Young had eight thoracic bristles.

(c) STRUCTURAL.

In British Seas *Filograna implexa* has been at intervals under examination since 1863, and it was its structure that year in St. Andrews Bay which showed how closely it approached Prof. Huxley's *Protula dysteri*. Indeed, two years after, the English author admitted to the writer that there was no real distinction between them. Since that time numerous specimens from the east and west, north and south, from shore and from deep water, and from such localities as Norway, Shetland, the Hebrides, several stations (7) in the North Sea, Plymouth, the Channel Islands, the trawling-grounds of 1884, the deep water off St. Andrews Bay, the Moray Frith, the stations of the 'Porcupine,' Naples, the stations of the 'Triton' and 'Knight Errant' from the Red Sea, India, Africa, Australia, and the French coast, &c., have given a fair field for observation, especially when supplemented by living specimens.

Fresh examples from Plymouth in sea water, as Huxley and others truly said, resemble corals in so far as the branchial fans of the annelids project from the tips of the tubes as miniature flowers, the distal parts (branchiæ) of

which are pale greenish yellow, and the anterior region of a fine reddish hue which tints the cephalic region at the base of the branchiæ and passes a short distance along each filament. When eggs are present the posterior region is also reddish, the colour of these being of a brighter hue than the front. Two dark eyes occur on the dorsum of the reddish cephalic area. The anterior (thoracic) membrane is more deeply tinted in front than behind. When in full vigour the pure white of the calcareous tubes, the scarlet of the anterior region which just projects beyond them, and the pale greenish-yellow fans with their opaque tips make a picture at once beautiful and characteristic. The filaments of the branchiæ, when fresh, show under a low power a distinct moniliform arrangement of granular dots in all the British forms along each side—indicating a less developed stage of the more highly organized condition in the Mediterranean form—*Salmacina ædificatrix*. These granular masses are situated on the outer aspect of the interpinnae spaces, and are prominent in a face or a lateral view. The tips of the branchiæ are in all more or less cylindrical, and under a lens present a whitish opacity. The expanded branchial fan is even more beautiful than that of *Alcyonium* from the larger size and greater richness of the filaments and pinnae. The separate filaments are often curved toward the mouth, approximated, expanded or drooped on one side, the movements in the absence of irritation generally being slow. When touched with a needle, however, the entire fan shrinks into the tube, and though it by-and-by unfolds it may sharply retract several times spontaneously as if in remembrance of the contact of the foreign body. The collar is often folded backward over the tip of the tube when the branchial fan is expanded. A separate branchia retains vitality for a considerable time and the pinnae move as in the perfect fan, the tip of the filament also bending inward as if carrying out its usual functions, the whole occasionally rolling together like a ball and again expanding. The funnel-like aperture leading to the mouth is richly ciliated, and so with the anal groove posteriorly. Cilia also occur at the bases of the feet.

On arrival at St. Andrews those from Plymouth expanded their branchial plumes freely, and after the first two days various examples dropped from their tubes to the bottom of the vessels, and this continued during several weeks. The extruded forms quietly expanded their branchiæ on the bottom of the vessels, the filaments bending inward now and then and again being expanded, whilst those with long

posterior regions occasionally curved them as the body contracted—with or without a jerk. Fragments of the anterior region with the branchiæ survived a week or more, the movements of the branchiæ being similar, and even a cephalic region with the branchiæ had almost equal vitality. The distal process of the branchial filament is not ciliated, but a rich coating of cilia occurs on the inner surface of the pinnæ.

In reviewing the various examples from the diverse localities it is found that the mass of calcareous tubes—the vermidom, as Huxley called it—is identical in all, though two conditions may be distinguished, the solitary and the social. The tubes from deep water are large, yet light, masses, which invariably, as Dalyell observed, are honey-combed by spaces which permit the free passage of water and enable the annelids to expand their branchial fans in secure retreats. Therein they differ from the solid masses of the aporous corals, for instance, which lack the intricate chambers and which can only expand their polyps on the surface and sides. In some a distinct widening of the lip of the tube occurs, after the manner of a trumpet—a condition perhaps less frequently seen from their extreme brittleness.

The general size of the adult annelids does not offer much variety, though the Neapolitan examples, such as *Salmacina edificatrix*, are pre-eminent.

The branchiæ vary considerably in their total length, in the length of their pinnæ, in the presence or absence of terminal enlargements to the filaments, and in the development of the paired glands at the base of the pinnæ. Moreover, the presence of opercula characterizes certain forms, yet they are not altogether confined to northern examples, since they are abundant in those from the Channel Islands and off Cape Sagres in the south of Spain. Opercula are absent from the Mediterranean examples, those from Plymouth, those from Madeira, India, and Australia, yet they are equally absent from swarms off St. Andrews Bay. So much has been made of the presence or absence of opercula that it is interesting to find that the enlargements at the tips of the filaments seem to take their places, for instance, at Naples and Plymouth. Where an operculum is present, as a rule no enlargement of the tips of the filaments occurs. The opercula may be comparatively large and thin, or less expanded as circular discs. But the most important fact is that on the same ground, as in Shetland, the Moray Frith, and St. Andrews, some in the same masses have and others do not have opercula. Thus in

swarms of those devoid of opercula from the neighbourhood of the Bell Rock a few were found with them. That fact would seem to dispose of the importance of the operculum as a specific distinction, for the animals are otherwise identical. In the same way some on the same masses from the North Sea had an operculum as an exception, and though Sars described the Norwegian representative as having an operculum, others lately examined from the same region had none. The varying size and shape of the operculum, and the remarkable susceptibility of the branchiæ themselves to change in filaments, pinnæ, terminal region, and glands, suggest the instability of a character derived from the operculum in *Filograna*.

The tips of the filaments, like the branchiæ as a whole, present equal response to external or internal influences. The maximum change, independently of the formation of an operculum, so far as at present known, is observed in the Neapolitan type—*Salmacina edificatrix*,—in which the non-ciliated tip forms an elongated sausage-like process, though it is probably flattened. No operculum is developed in this type. Similar, though smaller, enlargements take place in the Plymouth and southern non-opercular forms, and which, though not specially noted by Huxley, were alluded to by Claparède. De Quatrefages supposed that in Huxley's *Protula dysteri* these enlargements corresponded to the ovigerous opercula of the Spirorbids.

In those with opercula from the French coast, the Channel Islands, Shetland, and Norway, no enlargement of the terminal region of the filaments, as a rule, was present. Only in certain examples from the North Sea modified opercula and terminal enlargements of the filaments occurred. Thus in an example with eight pairs of anterior bristles one dorsal filament had a somewhat thick terminal process, rather abruptly bevelled on one side, whilst the other filament had advanced a stage further—the clavate tip being unequally bevelled and hollowed so as to form a rudimentary operculum. On the same ground (455 metres) another had the tips of the filaments more irregularly enlarged as flattened lobate processes in every instance, and in several the expansion passed down the filament for some distance. Others showed similar enlargements at the tips of the branchiæ and no opercula, and a third series presented a minute flattened or slightly saucer-shaped operculum on each dorsal filament which could have been of little use as a protection. At other stations the forms of the opercula varied from the thin translucent, more or less circular or hoof-shaped cup to a

long vase with a tapering process on the lip, or the filament had a blunt clavate tip or a cone at the end. In another instance (197 metres) in which no operculum was present the tips of the two dorsal filaments were simply flattened and wider than the rest. Accompanying the foregoing were several—it may be young forms—in which the tips of the filaments were short and little tapered. The presence or absence of opercula, indeed, would appear to depend on no reliable data.

Variability is not confined to the tips of the branchial filaments, for the pinnae are short as in the young budding forms from Plymouth, or of great proportional length as in certain forms from the North Sea, the branchial fans of which, moreover, are about half the length of the body. The pinnae of these are much longer and more slender than in any from Plymouth, though the age of the specimen has considerable influence in this respect.

The number of the bristle-tufts in the anterior region is likewise variable—ranging from five to ten, though a considerable majority show seven, the number most frequent in the north.

The first pair of bristle-tufts, the collar-bristles, diverges from the others in size, direction, and structure, and in these respects is closely allied to the condition in *Spirorbis*. Those from Plymouth may be taken as the type, the first pair of bristle-tufts being conspicuous organs directed forward, upward, and outward. The shaft of each bristle is nearly cylindrical, diminishing a little when viewed from behind toward the commencement of the wing, and the tapering axis can be followed as distinct from the wing to the hair-like tip. The broad basal part of the wing has numerous (about a dozen) serrations, sloping from the base to the distal end in lateral view, then a hiatus occurs, followed by a minutely serrated tapering wing or blade. Certain views point to the double nature of the basal expansion of the wing. In some from St. Andrews several of the bristles of this tuft do not show the gap separating the more boldly serrated base from the minutely serrated terminal region of the wing. Moreover, a few simple tapering bristles without an evident wing were present. How far these may consist of developing forms has yet to be ascertained, but such is unlikely. These bristles are freely moved forward, outward, and inward for various purposes, and when feeble or dying they stand stiffly forward and outward. In the buds these bristles show the same structure, and slight hollows at the site of the gap between the basal and distal parts of the wing indicate the notch.

The second tuft has bristles with simple wings. The rest of the tufts in the anterior region have, in addition to the simple winged bristles, two or more with sickle-shaped or falciform tips, and in the ordinary preparations (microscopic) these are posterior. These tips are translucent and flattened, widened at the end of the shaft, characteristically curved and tapered to a fine point.

The bristles of the posterior region are few in number in the groups, and follow a blank space behind the anterior region. Though smaller, the structure is the same as the simple winged forms. The wings on the slender bristles of the last three or four segments are very narrow—just visible in living examples.

So far as can be ascertained, the hooks in the various forms correspond in intimate structure.

Though the Polychæta as a rule are unisexual, various hermaphrodite annelids are known; thus H. Parlin Johnson gives a list of sixteen or seventeen species possessing this character. No form, however, is more interesting than *Filograna* (Salmacinae) which not only is hermaphrodite, but reproduces also by budding, as first pointed out by Huxley. In the hermaphrodite annelids, as Malaquin clearly observes, the male and female gonads may be quite distinct, as in the Nereid *Lycastis quadraticeps*, Gay, or they may be mixed, as in *Ophryotrocha puerilis*. In the Salmacinae and Spirorbids, on the other hand, the male and female gonads are in different segments.

The budding in *Filograna*, as Sars noticed, takes place in the posterior region of the adult, viz., where the long paired bristles occur—six or seven of these being in front of the bud, which is formed of the caudal region of the nurse-stock with the vent and its two papillæ.

The early buds are ovoid and granular, wider than the ordinary caudal region, with nine or ten pairs of bristle-tufts characteristic of the posterior region, the anterior division being devoid of them, but having simple smooth filaments representing the branchiæ. No special differentiation of the granular interior of the bud can be made out, further than a more opaque granular wedge in front of the anal papillæ, and which probably represents the adult rectum. No trace of the collar is at first visible, then a fold, probably the ventral, occurs at the base of the short filaments.

In the next stage the body of the bud is more elongated, the bristled segments are more numerous, and a streak along the middle line leads to the vent, and is in contact anteriorly with the alimentary canal of the adult, which in one contained a large foreign mass about its middle. The branchiæ

(four on one and three on other side) are longer and more slender, and are distinctly moniliform. A rounded process behind them on each side represents the lateral lobes of the collar, and a slightly opaque curved area on the anterior region probably indicates the alar membrane.

The buds appear to leave the nurse-stock when six pairs of anterior bristles are present, viz., the first pair which project horizontally and five behind these, the alar membrane being narrower behind than in front, and developing from before backward. The branchial filaments have pinnæ and terminal processes. The body is comparatively short and wide, the anterior and posterior regions being nearly equal in length. A part devoid of bristles occurs behind the anterior region, then follows ten or eleven bristled segments and a caudal region devoid of bristles.

In many from Plymouth the anterior part of the posterior division, the seat of the male elements, is marked by numerous closely arranged transverse lines apparently due to transverse rows of minute red pigment-granules on the stomach; yet in these the male elements at this date (8th June) had not attained great development, the ovigerous region behind being considerably in advance, as might be anticipated in view of the presence of the ova in the early bud. A portion of the tail, consisting of a variable number of segments (12-15 or more), being free from reproductive elements and presenting only the greenish blood-vessels of the gut and the feet. The contrast, therefore, between such specimens and those forwarded in March, in which month the reproductive elements were inconspicuous, though buds were numerous, was pronounced. In June, again, the budding forms had reproductive elements developed only in the bud, the reddish hue of which betokened the early ova, only a median greenish stripe, broad at the vent, indicating the alimentary canal in the bud ready to separate. Such subsequently developed a caudal region of numerous segments.

No uniformity appeared to exist as to the segment of the posterior region from which the bud sprang, for example, six, seven, eight, nine, and ten bristled segments occurred in a series in front of the bud.

The sperms frequently develop in the forms from Plymouth a little later than the ova, none indeed appearing in the bud, but by-and-by they fill the non-bristled region in front of the ovigerous segments and bulge laterally, the region being thus characterized by its pallor.

On the other hand, a short example having about twenty-five segments in the posterior region had only male elements in front of a part, containing thirteen segments and the

pygidium. The achetous region (of four or more pale segments) was filled with sperms—some ripe, the majority scarcely ripe. The sides of the posterior region, which would by-and-by form the bud, had opaque cells and granules (developing ova?). The sperms thus first attained maturity in the example. This, therefore, shows the variable nature of the form in this respect.

On the 9th June early trochospheres of a deep red colour occurred in the vessels, the prototroch being conspicuous at each side. These simply rotate or swim in small circles; but the larvæ with commencing segmentation dart through the water with great vigour, and often in a straight line, whilst others made larger circles near the bottom. One of the latter had three segments behind the head, and in all two eyes were distinct.

The mode of development in these forms thus differs from that observed in the preparations of *Salmacina edificatrix*, which produces large ova and trochospheres in the tube. No buds have been met with.

(d) GENERAL.

Filograna in itself demonstrates the difficulties which surround the idea of special creation as an explanation of the diverse conditions of structure and reproduction, since those with and those without opercula, those with enlarged tips to the branchiæ and those without them, those with eyes and those devoid of them, those with a few pairs of anterior bristles and hook-rows and those with an increased series of both, and other variations occur on the same site. It is more reasonable to believe that the observer is dealing with a species spread over the whole globe, and which is endowed with a capacity for variation almost unequalled in the animal series, than to adhere to the view that there are separate species or genera.

The sea is in a different position from Mr. Alfred Wallace's view of the land, where "so long as a country remains physically unchanged, the numbers of its animal population cannot materially increase. If one species does so, some others requiring the same kind of food must diminish in proportion." In the sea such strictures, perhaps, are less necessary, for there is an ample margin for every living form in so far as food is concerned. It is true "the numbers that die" (or are killed) "annually must be immense; and, as the industrial existence of each animal depends on itself, those that die must be the weakest—the very young, the aged, and the diseased; while those that prolong their existence can only be the most perfect in health and vigour—

those who are best able to obtain food regularly, and avoid their numerous enemies." It is difficult, however, to see how such an argument can apply to sedentary zoophytes which are browsed on by young cod, to the living corals which are crushed by the *Scari*, or to the sedentary Polychaets in calcareous tubes which are devoured by Echini and various fishes. It would be interesting to find out in these the "struggle for existence in which the weakest and least perfectly organised must always succumb." There is little competition in a colony of *Filograna*, or in that of *Obelia*, and it can hardly be said that there is a struggle for existence in such reef-corals as *Polythoa* or *Zoanthus*.

Checks there must be on the extraordinary powers of propagation shown by *Filograna*, else the ocean would swarm with masses like coral-reefs, yet individual competition must be slight, since post-larval forms secrete their tubes, it may be, on new sites, whilst the buds may increase the parent mass of tubes on the old one. Each is perfect and capable of "performing the different acts necessary to its safety and existence under all the varying circumstances by which it is surrounded," and "perfect acquaintance with its organization and habits" would hardly enable us "to calculate the proportionate abundance of individuals which is the necessary result." It cannot be said that the inhabitants of the sea are "kept down by a periodical deficiency of food," though other checks exist. It is difficult also to explain the comparative abundance, say, of *Filograna* or the scarcity, say, of *Placostegus* as due to their organization and resulting habits, "which, rendering it more difficult to procure a regular supply of food and to provide for their personal safety in some cases than in others, can only be balanced by a difference in the population which have to exist in a given area."

If it be supposed that the ancestral form was devoid of an operculum, and that the presence of that organ in one form or another is a variation, the question as to its influence on the welfare of the species naturally suggests itself. Can the thin, almost membranous, operculum so guard the aperture of the tube as to be a decided advantage to the occupant—in contrast with the bare tips of the branchiæ or their enlarged extremities, which otherwise block it? The indiscriminate occurrence, in the same colony, of opercula, enlarged tips, and ordinary tips, would point to the view that the development of one or other of these is of secondary moment; yet it must be borne in mind that in certain northern localities the majority follow one condition or another, and that such races as *Salmacina œdificatrix* are characteristic of the

warm Mediterranean waters. Environment would thus appear to be a factor of importance in some instances, if not in all. Moreover, it would seem to be as unnecessary to place the weight given by some authors on the presence or absence of an operculum as to separate like species of oxen by the presence or absence of horns. Some, like Claparède and Fauvel, perhaps, might be disposed to separate as distinct species those with and those without an operculum, or to regard either as a sudden and an important mutation in a given series. It may, indeed, be asked why *Filograna*, with such a tendency to variation in the organs mentioned, as well as in reproduction, has not developed along the lines indicated and produced descendants in which each variation fitted it to survive more readily than its fellows—whether as regards its somatic cells or its germ-cells, both of which are affected? The continuity of the germ-plasm does not appear to restrict the variations indicated, even in reproduction, since there may be free ova, internal embryos, or buds. A study of karyokinesis in the sexual cells might, perhaps, aid in solving the problem, though this is conjectural.

Again, the variability in the number of the anterior (thoracic) bristles is a feature seen in not a few Polychaets—for instance, in the Sabelids. In *Potamilla reniformis*, O. F. M., the anterior bristles may range from five to twenty-six pairs, a much wider variation than in *Filograna*. Certain races of *Filograna* have seven pairs, others from seven to nine, whilst the Neopolitan types may reach ten. Such is not necessarily the effect of age, but rather of environmental conditions—for example, the general temperature of the surrounding water, the rich supply of nourishment, and the abundance of light.

In considering the differences in structure presented by *Filograna* the variations in the tips of the branchiae occur under such diverse conditions, as well as on precisely the same site and under the same conditions, that one is at a loss to say wherein the process of selection and the "struggle for existence" lie. Their tubes give the necessary protection, so that the species can vary in any manner in which its inherent capacities permit, and a single generation may afford examples of change in the organs referred to. The enlarged tips of the branchiae are of a glandular character, and thus differ from the opercula—though borne by the same parts. Moreover, it cannot be said that disuse has caused the disappearance of the opercula, since the forms devoid of them have as much need of them as before. The bright pigment of the branchiae shows that light, as well as

eration, plays an important part in the economy of the annelid.

In such a type as *Filograna* it is not the hard-and-fast rule that "like begets like," but the inherent tendency to vary in every particular in the parts indicated is the main factor. It is questionable if, with every care, the production of those with opercula or those with the greatly enlarged tips to the branchial filaments could always be relied on by breeding from suitable parents of each type, unless the exact surroundings are obtainable, since the tendency to variability is so intense. It is said that varieties replace the original species because they are "more perfectly developed and more highly organised, and in all respects better adapted to secure its safety, and to prolong its individual existence and that of the race. Such a variety *could not* return to the original form; for that form is an inferior one, and could never compete with it for existence. Granted, therefore, a 'tendency' to produce the original type of the species, still the variety must ever remain preponderant in numbers, and under adverse physical conditions *again alone survive*"*.

Whilst many examples of the foregoing statement may be found in the higher vertebrates, the case of *Filograna*, for instance, does not seem to fall into line, for here are variations so numerous in structure and development and so intermingled with each other that it is difficult to say which is the original form and which the variation, since all forms may be found under like conditions. In this connection it may be asked what variety of *Filograna* has a tendency to maintain its existence longer than the original species or longer than any other variety? Can it be said that those with opercula are better fitted to survive than those devoid of them, or that those with the distal ends of the branchial filaments enlarged into sausage-like masses supplant those without them? Are those with eyes and nine pairs of anterior setigerous processes enabled to continue the species more effectively than those which have no eyes and only five or six setigerous processes? There is no proof that any of these is in a better position than another—yet Nature does nothing in vain; the facility with which variations occur and the vast distribution of the species would lead to the belief that a clue may yet be found to unravel the mystery. The species certainly fluctuates to and fro in regard to the organs mentioned, but does not progress along any of the lines

* This and other quotations are taken from the important papers of Mr. Darwin and Mr. Wallace in the Proc. Linn. Soc. vol. iii. no. 9, 1868.

with sufficient continuity to evolve anything more than a variation.

The differences in the various races of *Filograna* do not appear to be so great as to warrant specific separation, and this is the more noteworthy in a species so widely distributed and so plastic. The variations lead to no change of habit or surroundings, no essential change in general structure, and the different methods of reproduction remain more or less the same throughout. No variety seems to excel the other in its influence on the stability of the species, or to lead to fixity and the formation of a new species, and the "extermination of the older and less improved forms." This species does not conform to the view that the "lesser differences characteristic of varieties come to be augmented into the greater differences characteristic of species"*. If the struggle for existence held in the ordinary way, it is reasonable to suppose that certain variations of structure and development would have been singled out as permanent—to the exclusion of others.

The differences between the varieties of *Filograna* are more pronounced, perhaps, than in such a case as A. G. Mayer's *Epenethesis folcata* and *Pseudoclytia pentata*, the former with the typical four, and the latter with five radial canals, gonads, and manubrial lobes. The Cœlenterates, moreover, have a more simple structure, and their gelatinous tissues respond more easily to sudden variations.

Whilst there is wide variability in the plastic branchiæ, eyes, opercula, the number of "thoracic" segments, and the absence or presence of buds, there seems to be more or less uniformity in the structure of the bristles and hooks as well as of the tubes from pole to pole of the world. It may well be asked why the environment has not altered these organs (bristles and hooks)? Their functions, it is true, have not altered, but neither have the functions of branchiæ or opercula.

Yet, after all, and taking a broad view of the species, *Filograna* remains the same, and leads to no other type, for the Spirorbids, which have similar collar-bristles and branchiæ, are joined by no intermediate forms, their tubes are coiled and massive, and their opercula larger and calcareous. No change of surroundings in the varied waters stretching from Arctic to Antarctic seas makes the species other than *Filograna*. Moreover, there does not seem to be any correlation in the parts which vary, even the absence of the opercula and the presence of the enlargement of the tips of the branchial filaments are by no means

* Darwin, 'Animals and Plants under Domestication,' vol. i. p. 7.

invariable. In the Neapolitan *Salmacina œdificatrix* many specimens would seem to show shorter and more slender pinnæ on the filaments, which throughout are terminated by the enlarged cushions.

The higher Polychæts, as a rule, have the sexes separate, but *Filograna* is hermaphrodite, and, moreover, increases by active budding, the buds rapidly developing sexual elements which may be shed or the ova may be fertilised internally and find exit as larvæ. All these processes exist, it may be, in one and the same colony, and it is not easy to explain why such diversity should occur, or why such characters, if acquired, should not be more stable.

There is little evidence of a struggle for existence in such a form, since the sea supplies at once food and calcareous matter everywhere; yet the warmer waters appear to favour the development of larger processes at the end of the branchial filaments in certain cases, but this falls under environment rather than individual competition, for it cannot be supposed that the great size of these processes is necessary for the well-being of the species generally. Whilst they may be associated with the environment, yet under the same conditions small terminal processes may be present, just as in colder waters opercula may be present or absent in the same colony. In connection with the statement that the warmer waters seem to favour rapid spread of the species it need only be pointed out that, in contrast with the colder eastern waters of Scotland, *Filograna* flourishes luxuriantly in the genial waters of the Laboratory at Port Erin and speedily blocks with its calcareous tubes the supply-pipes, whilst on the boats of Dongonab in the Red Sea it is equally, if not more, luxuriant.

Sexual selection would appear to have little or no effect in producing the varieties, though special varieties of opercula or branchiæ on a given site may owe their frequency to the qualities transmitted by parents, or by the process of budding from a nurse-stock.

The coloration of the branchiæ is a feature of moment, especially in connection with the incidence of light. This coloration is marked in the Australian forms and in those from the Red Sea, the Mediterranean, and the south generally, though it is by no means inconspicuous in those of colder climes. Is this coloration protective where it is highly developed, or is it only ornamental? The great beauty, as well as the endless variety, of the branchial circles or fans of the Serpulids must have struck every marine zoologist, and therein *Filograna* agrees with its family; but the pigment may have special physiological purposes to

perform, seeing that the cœlomic fluid is present in every branchial filament.

The effects of inbreeding can hardly affect the reproductive processes of this species, since the sperms are widely distributed in the water and fertilise, it may be, different ova either in the cœlom or in the free condition, whilst the buds form a further check of importance. Notwithstanding the wide range of the sperms shed by such forms in the sea, the question of hybridization does not appear to arise—indeed, no more than in the case of the cod, haddock, and pleuronectids which meet on the breeding-grounds.

Reversion or atavism appears to have little to support it in the case of *Filograna*, though the occurrence of a few with opercula in a race usually devoid of them may be held by some to indicate this feature, especially as the development of this organ seems to be less connected with the environment. If such organs appeared in a bud—that is, independently of sexual reproduction,—it might show that the tissues of nurse-stock and bud were imbued with an inherent continuity of plasm, which in function may remain latent or intermittently burst forth in the formation of such organs, just as the reappearance of coloured longitudinal stripes takes place in young feral pigs. Particular crosses may also favour the appearance or disappearance of opercula, enlarged tips to branchiæ, or other features in succeeding generations: as Darwin says “That a being should be horn resembling in certain characters an ancestor removed by two or three, and in some cases by hundreds or even thousands of generations, is assuredly a wonderful fact.” As *Filograna* is hermaphrodite the so-called secondary sexual characters have a more direct line of transmission.

Whether the variations noted are hereditary is still an open question, though it would appear that in some cases at least these are not sufficiently stable to lead to the formation of species. Certainly *Filograna* is under “conditions of life incessantly inducing fresh variability” (*Darwin*), and thus, perhaps, has a check to inheritance in the ordinary sense of the term. Perhaps the species falls under the group in which selection has not been applied, and thus distinct races or even species have not been conspicuously formed; certainly it is difficult to see how natural selection affects *Filograna* to any extent. The variability in this species is not due to crossing, food, climate, or inbreeding. It is inherent.

2. *On Harmothoe watsoni*, M'I., an var. *H. marphysæ*, M'I.

Whilst studying the structure and habits of *Lagis koreni*, Malugren, forwarded from Lanfairfechan, in North Wales, Mr. Arnold Watson found a Polyroid as a commensal in the tube of an adult annelid and he kindly sent it for examination along with some remarks on its condition in life. It measured about one-fifth of an inch in length, with white scales bearing reddish-brown markings, which at their interior ends joined to form crescents. Anteriorly was a red disk, probably due to the cephalic ganglia. The median tentacle was long, and one anal cirrus was seen, though most of the dorsal cirri had been shed.

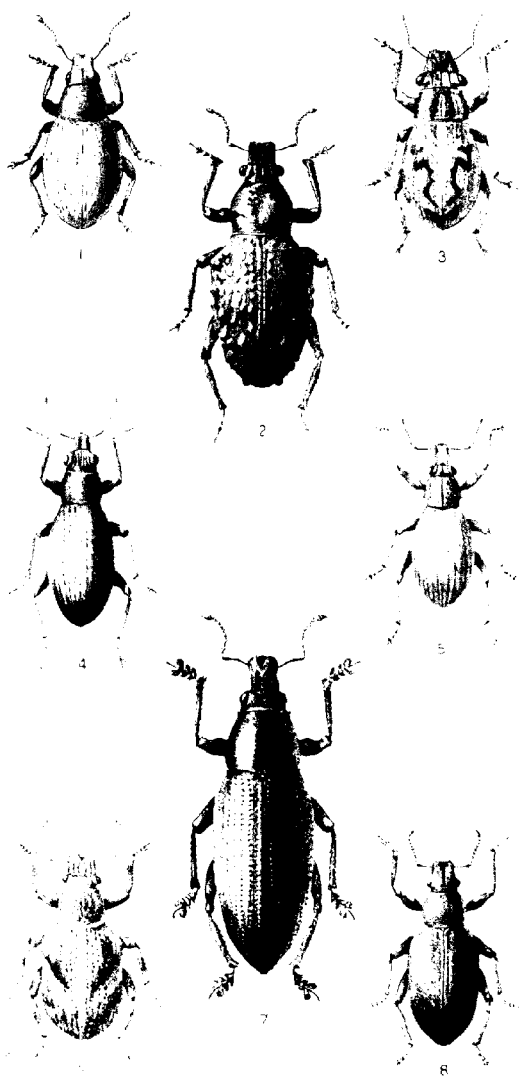
No scales remained on the body which had a fairly regular outline from the even disposition of the feet. The head is less elongated than in *Harmothoe marphysæ*, and in the preparation retained a pale brownish hue, with the usual median groove enlarging at the anterior peaks. The presence of these anterior peaks, which the dark pigment at the base of the median tentacle more clearly differentiates, the large size of the eyes, and the shorter head distinguish this form from *H. marphysæ*. All the eyes are visible from the dorsum, though the anterior pair, from their slightly lateral position, are less distinct than the posterior pair, which lie in front of the nuchal border. The anterior eyes are somewhat in front of the middle of the head, and thus separated from the posterior pair by a considerable interval, whilst they are also more distinctly lateral. Both pairs are, however, visible in a lateral as well as in a dorsal view, and all are of medium size, considerably larger than those of *H. marphysæ*. The median tentacle is long and furnished with clavate papillæ. The lateral tentacles are inferior and in the preparation have slightly enlarged or probe-shaped tips. The palpi are of moderate length with tapered extremities, and their surface is smooth. The tentacular cirri are comparatively short and have slender tips, whilst the surface has a few clavate papillæ.

The body is normal in shape, and thus differs from that of *H. marphysæ*, being slightly narrowed in front and more distinctly diminished posteriorly. The number of bristled segments is about thirty. When the scales are removed, a translucent bar, the proboscis, appears behind the head. The feet have a regular arrangement from front to rear, and the pale bristles project beyond them with similar regularity. A typical foot presents dorsally the cirrus, which is enlarged at the base and tapered distally, with numerous clavate papillæ. The tip of the organ does not project much beyond

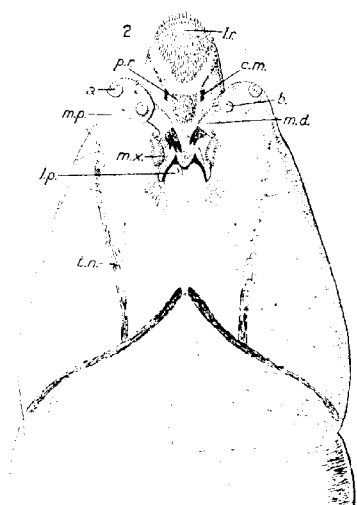
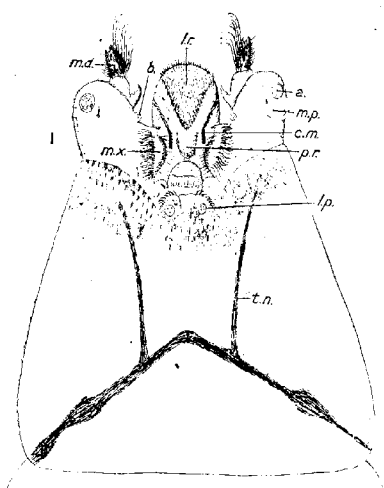
the bristles, and thus appears to be somewhat shorter than in *H. marphysæ*. A slight eminence below the cirrus gives origin to the pale dorsal bristles which radiate from it in a fan-like manner, but when compressed laterally show a shorter, stouter, upper, and a longer, more slender inferior series. The upper shorter forms are boldly curved and serrated on the edge. The more slender inferior bristles are less curved and the serrations on the hair-like tip are minute. A spine pierces the lower margin of the elevation from which the bristles emerge—in lateral view. These bristles thus closely resemble those of *H. marphysæ*, differing only in the more minute serrations of the tips and their smaller size. The inferior division of the foot forms a cone with a pointed tip, up to the base of which the powerful spine goes. Its dorsal outline is sinuous, the ventral convex (in lateral view), the outline thus differing from that of *H. marphysæ*, though the size in the respective cases has to be remembered. The upper two have elongated simple tips with only a slight swelling above the shaft and very minute serrations on the edge. Those in lateral view are above the spine. Those below the spine have shorter tips, longer rows of spikes, and bifid tips, and the swelling above the shaft is more distinct. The short ventral cirrus has an enlarged base which rapidly tapers to a slender tip, and its surface has a few clavate papillæ. Posteriorly all the parts of the foot are diminished, and the bristles are proportionally more slender and elongated.

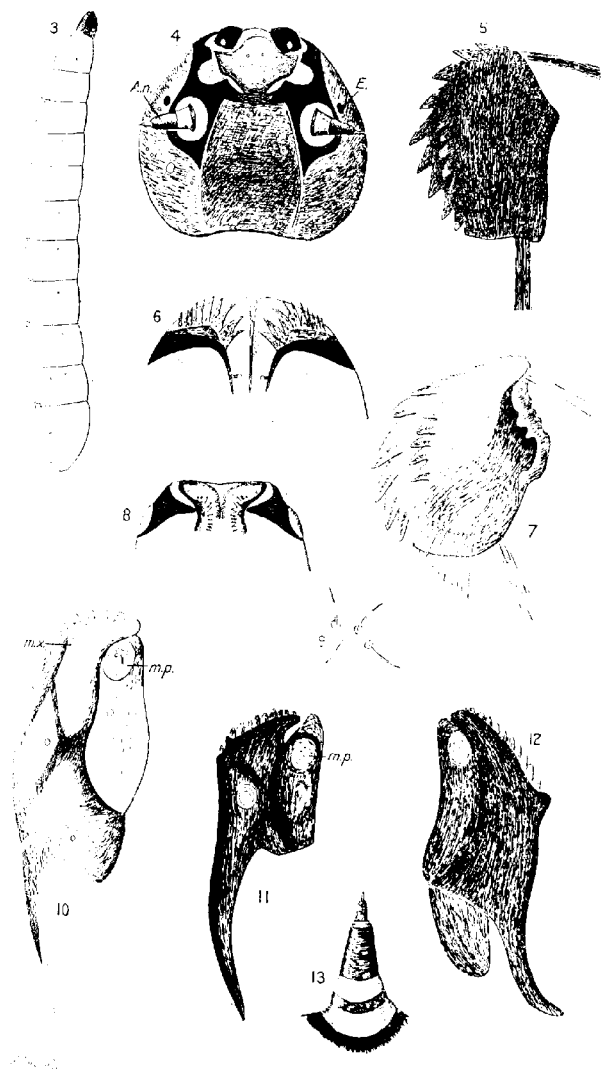
The scales have the colour mentioned by Mr. Arnold Watson, and a similar outline to those of *H. marphysæ*, but they are thinner and more translucent; moreover, in some no papillæ can be observed. In other scales the papillæ, from ten to twenty in number, form a small compact group on the thinnest margin of the scale and about its middle, whereas in *H. marphysæ* these papillæ stretch in the adult female as a long band to the angle of the thin edge. The changes here indicated may be the result of growth, but there is a decided divergence.

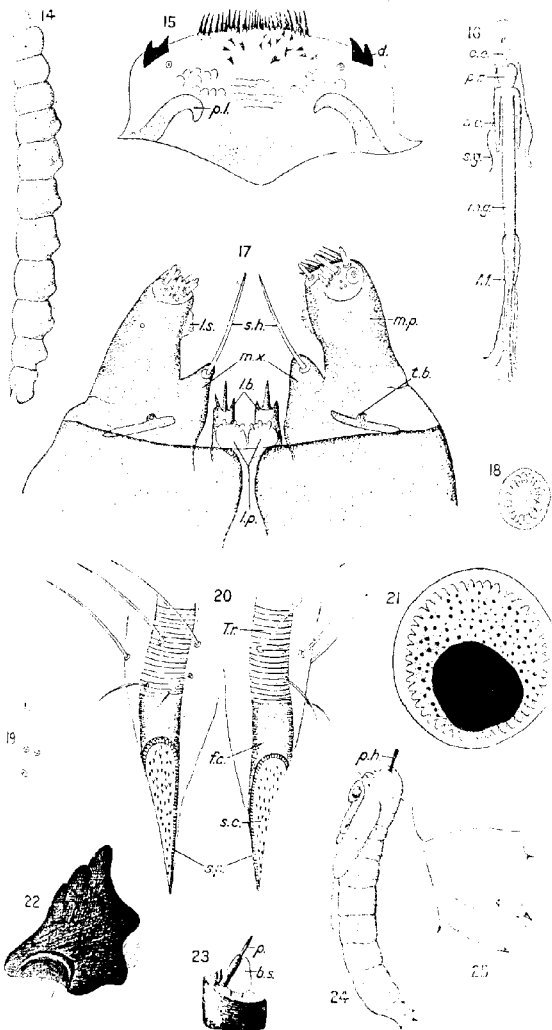
On the whole, this Polynoid closely approaches *H. marphysæ*, but the structure of the shorter head with its larger eyes, and the closer approach of the anterior to the posterior pair, the slight differences in the structure of the feet and the bristles all combine to cause hesitation. Intermediate examples, however, may yet enable future observers to unite them. It is an interesting fact, however, in connection with the ripe *H. marphysæ*, that a marked change in the condition of the feet accompanies reproduction, though the eyes remain as minute as before.

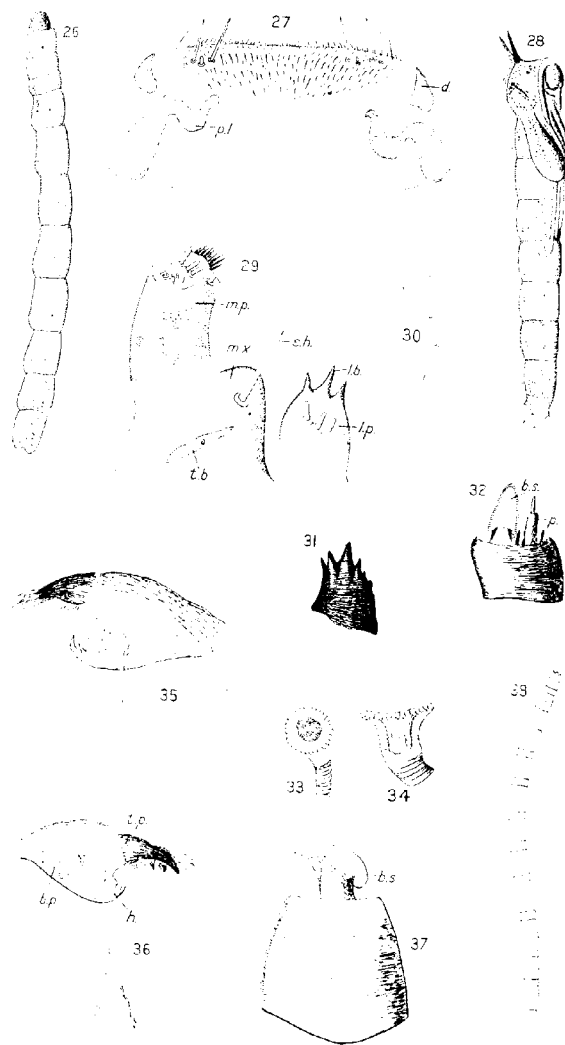


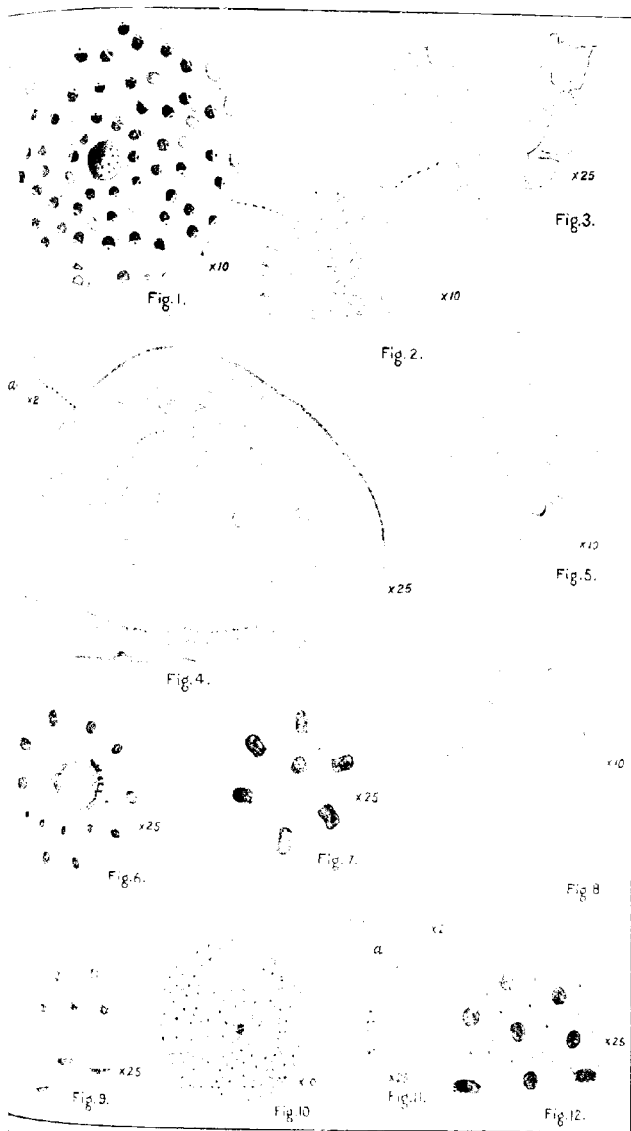
NEW AFRICAN CURCULIONIDÆ.











Batopora, Dal.

BATOPORA (BRYOZOA).